De-bushing Advisory Service

State and Trends of the Namibian Bush Biomass Sector 2019

Based on an inclusive survey
in line with the DAS indicator framework

Imprint

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List of Acronyms

BCBU	Bush Control and Biomass Utilisation
BIS	Bush Information System
BMCC	Biodiversity Management and Climate Change
CSIR	Council of Scientific and Industrial Research
DAS	De-bushing Advisory Service
DBN	Development Bank of Namibia
DEA	Department of Environmental Affairs
DoF	Directorate of Forestry
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FNB	First National Bank Namibia
FSC	Forest Stewardship Council
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GRN	Government of the Republic of Namibia
Ha	Hectare
LaRRI	Labour Resource and Research Institute
M&E	Monitoring and Evaluation
MAWLR	Ministry of Agriculture, Water and Land Reform (formerly MAWF)
MEFT	Ministry of Environment, Forestry and Tourism (formerly MET)
MIT	Ministry of Industrialization and Trade (formerly MITSME development)
MLIREC	Ministry of Labour, Industrial Relations and Employment Creation
NAD	Namibian Dollar
NAU	Namibia Agricultural Union
N-BiG	Namibia Biomass Industry Group
NCA	Namibia Charcoal Association
NCRST	National Commission on Research, Science and Technology
NECFU	Namibia Emerging Commercial Farmers Union
NNFU	Namibia National Farmers Union
NSA	Namibia Statistics Agency
NUST	Namibia University of Science and Technology
OPM	Office of the Prime Minister
SAIEA	Southern African Institute for Environmental Assessment
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
UNAM	University of Namibia
UHH	University of Hamburg

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Acknowledgements

We would like to acknowledge the contributions by all sector stakeholders, public servants and experts who responded to data requests, provided their advice and insights and made time for meetings and interviews. In particular, we would like to acknowledge the contribution by all farmers who took the time to participate in the farm-level survey and shared information about the operations on their farm. Thank you for your cooperation and willingness to share data and information, which is crucial to capture the state and development of the Namibian bush biomass sector.

We would also like to acknowledge the great work by the farm-level survey enumerator team, Mr. Uhangatenua Kapi, Ms. Helvi Shindume and Mr. Peter Shikalepo.

We hope that this report can make a humble contribution to the regular monitoring and the further development of the sector.

Executive Summary

The report summarizes the findings of a sector-wide survey of the Namibian bush biomass sector in line with a sector M&E framework developed by the De-bushing Advisory Service (DAS) in order to estimate the current state and extent of bush control and biomass utilization (BCBU) and related value chains, revenue streams and employment figures at the national level.

The Namibian bush biomass sector is a growing sector and has the potential to significantly contribute to the national economy through the establishment and strengthening of both domestic and international value chains and corresponding employment creation. The availability of reliable sector data is essential to appreciate the importance of the sector and its development over time and, importantly, to forecast and shape the future sector development. Systematic sector data allows for evidence-based decision-making in order to tailor sector support policies, interventions and instruments to maximize the benefits for Namibian land users on both commercial and communal farmlands and the Namibian economy at large.

The primary aim of the survey was to determine the status of all sector indicators as defined by the DAS for the year 2019. Where available and realistic, the survey further aimed to collect data for previous years. The current approach to data collection combined a farm-level survey and targeted collection of existing datasets and primary data from key stakeholders. This proved useful in that it provided two or more independent estimates for numerous indicators, thus allowing for some degree of triangulation and consistency-checking of assumptions:

- A phone-based farm-level survey was conducted in April and May 2020, focusing primarily on (emerging) commercial farmers. Out of a total of 407 farmers who were contacted, 213 participated in the farm-level survey. The corresponding data was used to derive bottom-up estimates of national-level indicator values.
- Primary data was collected from sector stakeholders such as the Namibia Charcoal Association (NCA) and private sector stakeholders such as BCBU-related service providers.
- Existing datasets were used to derive top-down estimates. For example, trade statistics from the Namibia Statistics Agency (NSA) were used to estimate some relevant indicators.

The survey results show a clear trend of the Namibian bush biomass sector as a growing contributor to the national economy through value creation and employment, as all indicators consistently show significant growth.

The bush biomass value chain starts with the control and harvesting of encroacher bush. It is estimated that slightly more than 300,000 ha were under a form of bush control in Namibia in 2019 (see Fig. A). Compared to the 2010 estimate, this corresponds to an annual growth rate of more than 6%. Overall, the total area under bush control over the last 10 years (2010 to 2019) is estimated at close to 2 million ha. For 2019, about 220,000 ha are attributed to manual/semi-mechanized bush control, close to 70,000 ha to chemical bush control and roughly 20,000 ha to mechanized bush control.

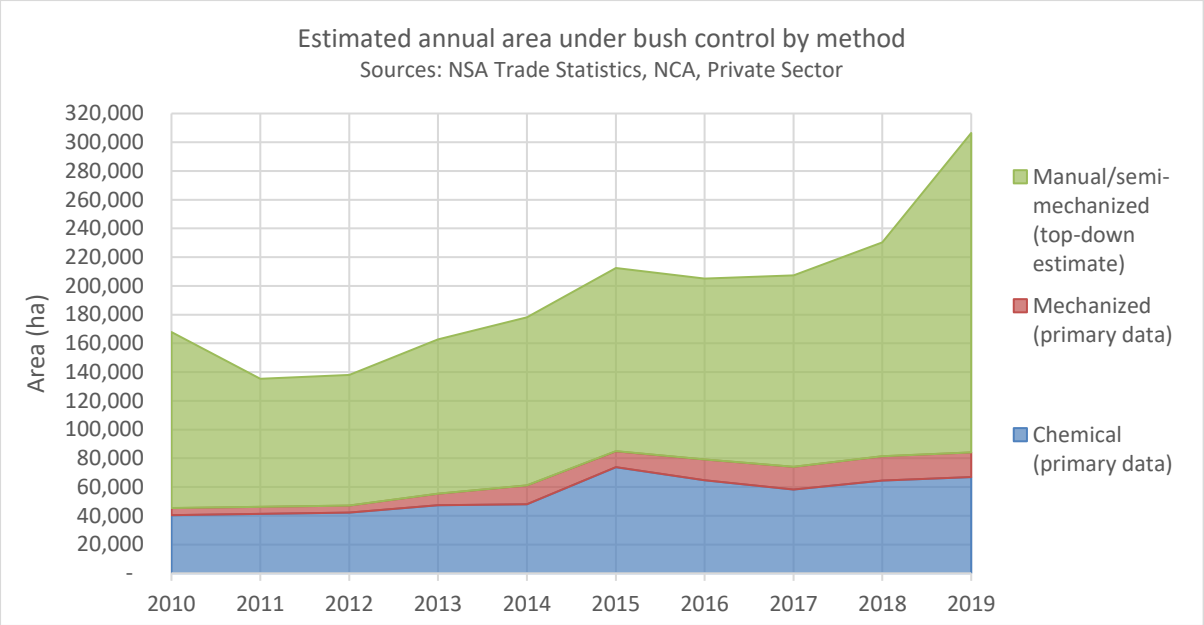

Fig. A: Estimated annual area under bush control by method, 2010 – 2019.

In terms of market and business development, the charcoal industry is the largest and best developed subsector of the Namibian bush biomass sector. Virtually all charcoal produced in Namibia is exported, making Namibia one of the largest global exporters of wood charcoal, consistently ranging among the top ten exporters during the past decade. Annual charcoal exports as recorded in official Namibian trade statistics have almost quadrupled over the past 15 years and stood at 185,820 tons worth 662.5 million N$ in 2019 (see Fig. B). Note that the Namibia Charcoal Association (NCA) estimates that the share of exports to Europe is even higher. The NCA estimates that about 55-60% (i.e. at least 100,000 tons) of Namibian charcoal were exported directly to Europe in 2019.

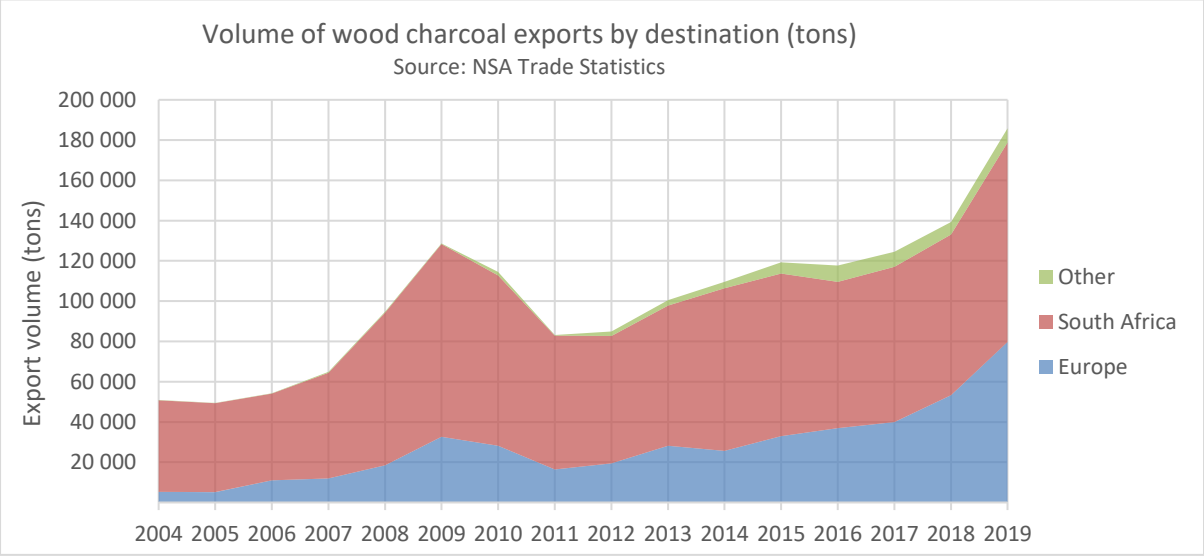

Fig. B: Annual volume of wood charcoal exports by destination 2004 - 2019. Source: NSA Trade Statistics.

The export value per ton of charcoal has increased consistently over the past 15 years. Significantly higher prices can be achieved from exports to Europe than to South Africa. According to the 2019 NSA trade statistics, a ton of charcoal exported to South Africa was on average worth 1,872 N$, whereas the value for export to Europe was almost three times higher with 5,522 N$ per ton.

Bush-based animal feed, while being a promising way of utilizing encroacher bush, has not yet developed in an organized subsector. In drought years, it seems relatively common that farmers add encroacher bush to their livestock feed, albeit production happens predominantly for own use and hardly in a commercial way thus far. Based on the farm-level survey, it is estimated that Namibian farmers produced more than 100,000 tons of bush feed in 2019, predominantly for own use. It is further estimated that about 6,500 tons of bush feed with an estimated value of 14 million NAD were sold in 2019. While this seems impressive, these figures are small compared to the 2019 lucerne imports from South Africa, which amounted to almost 60,000 tons.

Further bush biomass products are wood fuels. We estimate that more than 120,000 tons of firewood were produced from encroacher bush for own use in 2019. Furthermore, it is estimated that slightly more than 50,000 tons of firewood produced from encroacher bush were sold in 2019 at a total value of 70 million NAD. Produced and commercially traded amounts of wood chips/pellets for industrial combustion and bushbloks in 2019 were estimated at in 34,000 tons and 10,000 tons, respectively.

In terms of employment creation, it is estimated that the Namibian bush biomass sector employed about 11,300 people in 2019. Three quarters of these are estimated to be employed at the farm level in line with charcoal production. Altogether, the charcoal subsector is estimated to account for 87% of the sector employment. (see Fig. C). Employment in bush feed production was estimated at close to 1,000 jobs in 2019. However, this may be an exception due to the extreme drought conditions in that year.

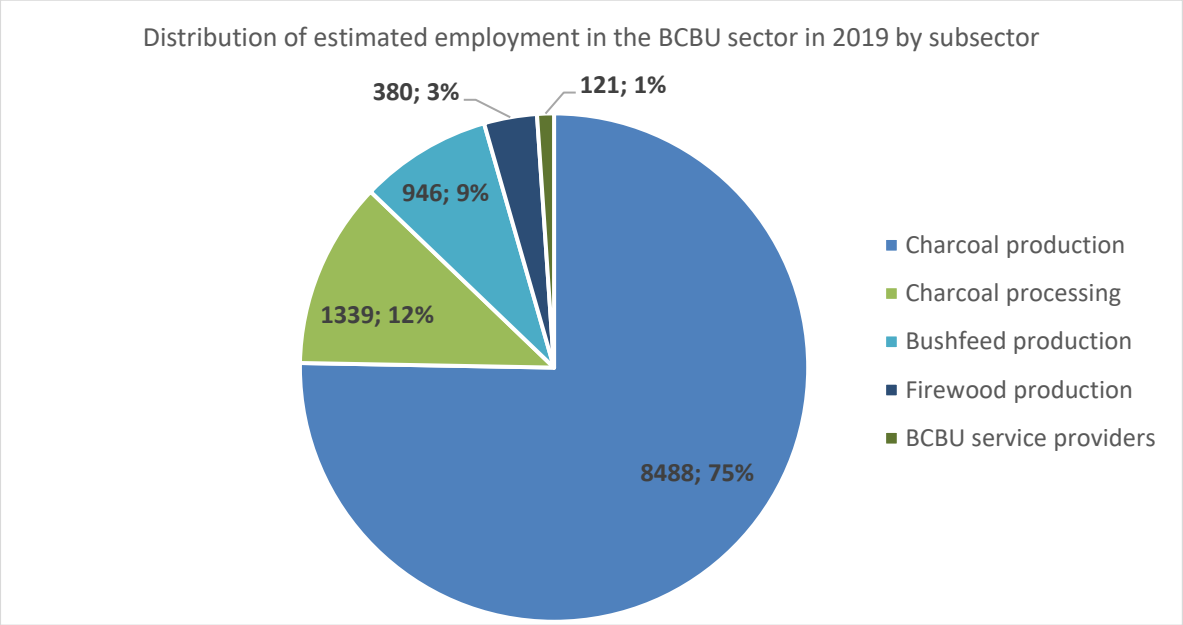

Fig. C: Estimated employment in the BCBU sector in 2019 by subsector.

Financial support instruments tailored to BCBU-related operations are scarce, but available. Both AgriBank and FNB offer specific instruments. However, according to estimates derived from the farm-level survey, these were hardly made use of in 2019, possibly because the priorities of most farmers lay elsewhere during the drought.

All relevant indicators show consistent growth over the last ten years, indicating significant growth and expansion of the entire Namibian bush biomass sector and suggesting a potential for further and sustained growth. While the charcoal subsector has become well-organized, other subsectors such as bush-based animal feed still needs to be organized and formalized. Nationally, an expansion of bush biomass utilization activities may allow communal farmers to capitalize on the bush biomass available in many areas. Internationally, the possible establishment of value chains involving the export of woodchips for energy generation is currently being assessed and may spark an additional subsector.

1 Introduction

1.1 Document Background

With the aim to establish and consolidate an M&E system for the Namibian bush biomass sector, the De-bushing Advisory Service (DAS) contracted D-Once Consulting CC to carry out a consultancy titled "Conduct an inclusive survey for implementation of the recently developed DAS Monitoring and Evaluation System". The task was to support the implementation of the DAS Monitoring and Evaluation (M&E) system for the Namibian bush biomass sector by

i) conducting a sector-wide survey in line with the existing indicator framework in order to estimate the current state and extent of bush control and biomass utilization (BCBU) and related value chains, revenue streams and employment figures at the national level; and

ii) identifying challenges and opportunities with regards to the indicators, processes and tools required to establish regular data capturing and reporting in future by relevant sector stakeholders and formulating corresponding recommendations.

The present report summarizes the activities and findings of this assignment. It aims to depict the current state of and trends in the Namibian bush biomass sector and describes the recommended approach for future data collection campaigns. The availability of accurate and up-to-date national-level estimates is expected to benefit all sector stakeholders as well as the Namibian economy as a whole as it will give both public and private stakeholders a comprehensive overview of opportunities and challenges in the sector and enable corresponding support policies, interventions and instruments to be tailored accordingly.

1.2 Rationale

Woody encroachment by indigenous encroacher species is estimated to occur on more than half of Namibia's land area and is considered a form of severe land degradation in the Namibian context, having significant impacts on the country's economy and savannah ecosystems. These impacts include drastically reduced agricultural productivity, changes in biodiversity, reduced groundwater recharge (De Klerk, 2004) as well as changes in soil fertility and carbon storage potential of savannah ecosystems (Turpie, et al., 2019; Seebauer, Pinkwart, Schwarz, & Hartz, 2019; GRN, 2019). While a more detailed quantification and characterization of these impacts (and the impacts of bush control) in the Namibian context is a pending task, a study on the economics of bush encroachment (Birch, Harper-Simmonds, Lindeque, & Middleton, 2016) estimated the economic benefits of large-scale bush control operations (bush control on about 1 million hectares annually) in Namibia between 29 and 112 billion N$ over a period of 25 years as compared to a scenario with no bush control, assuming that the problem of bush encroachment is reversible, and that sustainable rangeland restoration is possible on large scale.

The encroacher bush biomass constitutes a natural resource and an opportunity for further value generation and addition. Bush control per se is an expensive and demanding exercise and hardly affordable on a large scale unless clear and tangible benefits materialize within a reasonable timeframe for the respective land user. Therefore, large scale bush control is only an economically viable option if further value can be generated from the encroacher bush biomass resource. Accordingly, a Namibian bush biomass industry sector has developed over the years, with an increasing degree of organization and formalization. The De-bushing Advisory Service, in cooperation with the MEFT/GIZ Bush Control and Biomass Utilization (BCBU) Project and the Namibia Biomass Industry Group (N-BiG), is supporting the development of this bush biomass sector in Namibia, aiming to turn encroacher bush into an economic opportunity.

The availability of reliable sector data is essential to appreciate the importance of the sector and its development over time and, importantly, to forecast and shape the future sector development. Systematic sector data allows

for evidence-based decision-making in order to tailor sector support policies, interventions and instruments to maximize the benefits for Namibian land users on both commercial and communal farmlands and the Namibian economy at large. It further allows the DAS to (non-causally) assess the sector development against its own support activities and plan its own interventions accordingly. It is against this background that the DAS has developed an indicator framework for the Namibian bush biomass sector, aiming to quantitatively capture both the state of the sector and its own support activities. In line with this framework, a sector-wide survey was conducted to determine the various indicator values for the year 2019 and previous years. This report summarizes the findings of this survey and provides corresponding lessons learned in order to facilitate and consolidate regular systematic data collection.

The Namibian bush biomass sector is a growing sector and has the potential to significantly contribute to the national economy through the establishment and strengthening of both domestic and international value chains and corresponding employment creation. The formal part of the sector is currently exclusively limited to commercial and resettlement farms, i.e. private-owned land, and comprises numerous farms and a limited number of commercial companies specialized in certain biomass products and/or service provision. Bush control and biomass utilization operations on communal land are currently highly restricted in Namibia, mainly due to concerns about uncontrolled over-utilization and unequal benefit distribution if such operations were allowed. The present report and the underlying data collection campaign thus focused exclusively on the commercial farmlands.

Note that the phenomenon of bush encroachment in Namibia as well as the various bush control methods and bush biomass utilization opportunities have been described in detail elsewhere and are not subject of this report. For further information on the above, the reader is referred to the DAS website at https://www.dasnamibia.org/download/, which provides a comprehensive archive of relevant literature.

2 Methodology

The primary aim of the overall survey was to determine the status of all sector indicators for the year 2019. Where available and realistic, the survey further aimed to collect data for previous years. The survey consisted of various components, attempting to tap as many relevant sources as possible in order to obtain direct or proxy data on a given indicator from various angles and allow checking for consistency and the derivation of best estimates through triangulation of the data from these sources.

We distinguished between two general data source types: Bottom-up (primary and secondary data) and top-down (secondary data).

- Bottom up data refers to initially disaggregated data from a sample (in this case down to the farm level), which can be aggregated and extrapolated to arrive at regional and national level estimates for the sector indicators, e.g. bush-thinned area by method. This dataset was collected through a structured survey among commercial farmers.
- Top-down sectoral data is already available, normally in aggregated form. An example of top-down data is the annual total volume of bush-based charcoal exported, which was cross-checked against charcoal production and sale figures derived from farm and processing plant level data. Top-down data is mainly secondary data collected from the mandated government authorities or primary data from the private sector (e.g. bush control service providers).

Generally, it was attempted to derive indicator estimates from both the bottom up and top down datasets and compare these estimates for consistency. The above data source types and estimates derived thereof were complemented by quantitative and qualitative data from both key informant interviews and existing literature.

Data collection took place between April and August 2020. Due to the Covid-19 related lockdown phase, data collection took place remotely. After the lockdown restrictions were lifted in May 2020, also in-person meetings and interviews took place. A total of 38 relevant key stakeholders were consulted, 28 of these via phone or email and 10 in personal meetings (see Annex A2 for more detail on stakeholders engaged).

2.1 Sector Stakeholders

In a first preparatory step for data collection, the relevant sector stakeholders and possible sources of relevant data were identified and recorded in a specifically developed relational database (see subsection 2.3). Stakeholder mapping was done both at institutional and individual level. Each institution was linked to the indicators to which it is expected to be able to contribute data to. Individuals in the stakeholder database are usually associated with one of the relevant institutions identified. The stakeholder database was updated continuously throughout this assignment and is expected to serve as a future key resource for the Namibian bush biomass sector M&E system.

2.1.1 Relevant Stakeholders – Institutional Level

Currently, there are 40 institutions in the stakeholder database (see Table 1). These institutions (or their members, respectively) are considered relevant sources and/or users for data collected in line with the present survey.

Table 1: Institutions that are considered relevant stakeholders of the bush biomass sector M&E system and corresponding data collection, possibly both as contributors and beneficiaries.

Name	Sector role	Data source category
Agribank of Namibia	Finance	Secondary Data Source
Alfa Charcoal	Industry	Primary Data Source
Biomass Producers Namibia	Industry	Primary Data Source
Carbo Namibia - CMO	Industry	Primary Data Source
Carbo Namibia (Pty) Ltd	Industry	Primary Data Source
CCF Bush (Pty)	Industry	Primary Data Source
CMO (Namibia) (Pty) Ltd	Industry	Secondary Data Source
De-bushing Advisory Service	Support	Primary Data Source
Development Bank of Namibia	Finance	Tertiary Data Source
Direct Charcoal	Industry	Primary Data Source
Directorate of Forestry (MEFT)	Policy-maker/Government	Primary Data Source
Environmental Investment Fund of Namibia	Finance	Tertiary Data Source
First National Bank Namibia	Finance	Tertiary Data Source
Forest Stewardship Council	Other	Secondary Data Source
Jumbo Charcoal (Pty) Ltd	Industry	Primary Data Source
King Charcoal (Pty) Ltd	Industry	Primary Data Source
Labour Resource and Research Institute Namibia	Research	Tertiary Data Source
Meat Board of Namibia	Industry	Primary Data Source
Department of Environmental Affairs (MEFT)	Policy-maker/Government	Primary Data Source
Ministry of Finance - Customs and Excise	Policy-maker/Government	Secondary Data Source
Ministry of Industrialization and Trade	Policy-maker/Government	Tertiary Data Source
Ministry of Agriculture, Water and Land Reform	Policy-maker/Government	Tertiary Data Source
Namagri	Industry	Primary Data Source
Namibia Agricultural Union	Farmer	Primary Data Source
Namibia Biomass Industry Group	Industry	Secondary Data Source
Namibia Charcoal Association	Industry	Secondary Data Source
Namibia Emerging Commercial Farmers Union	Farmer	Primary Data Source
Namibia National Farmers Union	Farmer	Primary Data Source
Namibia Statistics Agency	Other	Secondary Data Source
Namibia University of Science and Technology	Research	Secondary Data Source
NCRST	Research	Tertiary Data Source
Odusa Trading	Industry	Primary Data Source
Ohorongo Cement	Industry	Primary Data Source
Ombengu CC	Industry	Primary Data Source
Omuriro Biomass Investment	Industry	Primary Data Source
SASSCAL	Research	Tertiary Data Source
Standard Bank Namibia	Finance	Tertiary Data Source
University of Namibia	Research	Secondary Data Source

2.1.2 Relevant Stakeholders – Individual Level

The stakeholder database further contains relevant individuals as well as their contact details. These individuals include both potential key informants as well as farmers from the regions affected by bush encroachment. The contacts for the latter are essential for the farm-level data collection component of the survey (see subsection 2.2.1).

In order to collect as many contacts as possible for the farm-level data collection campaign, the various farmers unions were contacted. Target farmers were farmers from areas that are affected by bush encroachment, i.e. Otjozondjupa, Omaheke and Oshikoto as well as parts of Kunene, Erongo, Khomas and Hardap Region. Unfortunately, the management of institutions such as the Namibia Agricultural Union (NAU) and the Namibia Charcoal Association (NCA) are not allowed to share their members lists, thus the following approaches were pursued to obtain the contacts of their members:

- NAU: A call for participation in the baseline survey was placed in the weekly newsletter sent to all 2,000 NAU members on 03 April 2020. In addition, the call for participation was reiterated through a contribution to the weekly radio programme "Landboumikrofoon" on the NBC Afrikaans service on Saturday, 04 April 2020. Farmers willing to participate in the survey were requested to give their consent by submitting their contact details. Unfortunately, the response rate to this initiative was disappointingly low, with only 10 out of the more than 2,000 NAU farmers actively giving their consent.
- NECFU: Some 200 member contacts are publicly available on the NECFU website (https://necfu.org/). The NECFU leadership was contacted and gave permission that their members be contacted for the survey.
- NCA: A call to participate in the survey was sent to all NCA members through the NCA leadership. Interested farmers would indicate their readiness to the NCA leadership, who would then compile and share a corresponding contact list. However, according to the NCA management, the response rate was very low.
- FSC-certified farmers: A workaround to the low response rate by the NCA members was found by obtaining the contacts of the charcoal producers of FSC-certified group schemes (the major ones are CMO Group, Jumbo Charcoal, Direct Charcoal and Carbo Namibia). Under FSC management standards, members commit to sharing non-personal relevant data. According to the NCA, most of the members of these FSC group schemes are also NCA members. The contacts of more than 200 FSC-certified farms were identified.
- In addition, the DAS in-house contact database contained more than 300 contacts as of March 2020. The latter contains a mix of contacts, including (emerging) commercial and communal farmers as well as entrepreneurs.

Where farm name and number are known, the respective contact was linked spatially to the corresponding farm GIS data. A GIS shapefile emanating from the former Ministry of Land Reform containing was the only available spatial data for this exercise. While the corresponding data is somewhat outdated, particularly with regards to resettlement farms and corresponding sub-portioning, it was still useful for a significant share of contacts in the database, thus allowing to visualize the spatial distribution of contacts and survey data. Note that to protect personal data, no identifiable farm polygons will be published in this report. Instead, farm-level data will be visualized in form of density heatmaps. Figure 1 illustrates the distribution of commercial farms as in the current survey database.

The contact database currently contains 761 individual entries. Of these,

- 657 (86%) are individual farmers. Of these, 283 could be linked to one or more farms/farm portions (visualized in Figure 1) [1]. The total number of farm polygons which were linked to a farmer from the contact database is 369. This number is higher than the number of corresponding contacts because some farmers own several (often neighboring) farms or a given farm is stored in the GIS database as more than one polygon (often corresponding to different farm portions).
- 104 are other relevant contacts, e.g. representatives of relevant companies/institutions or experts on BCBU-related matters.

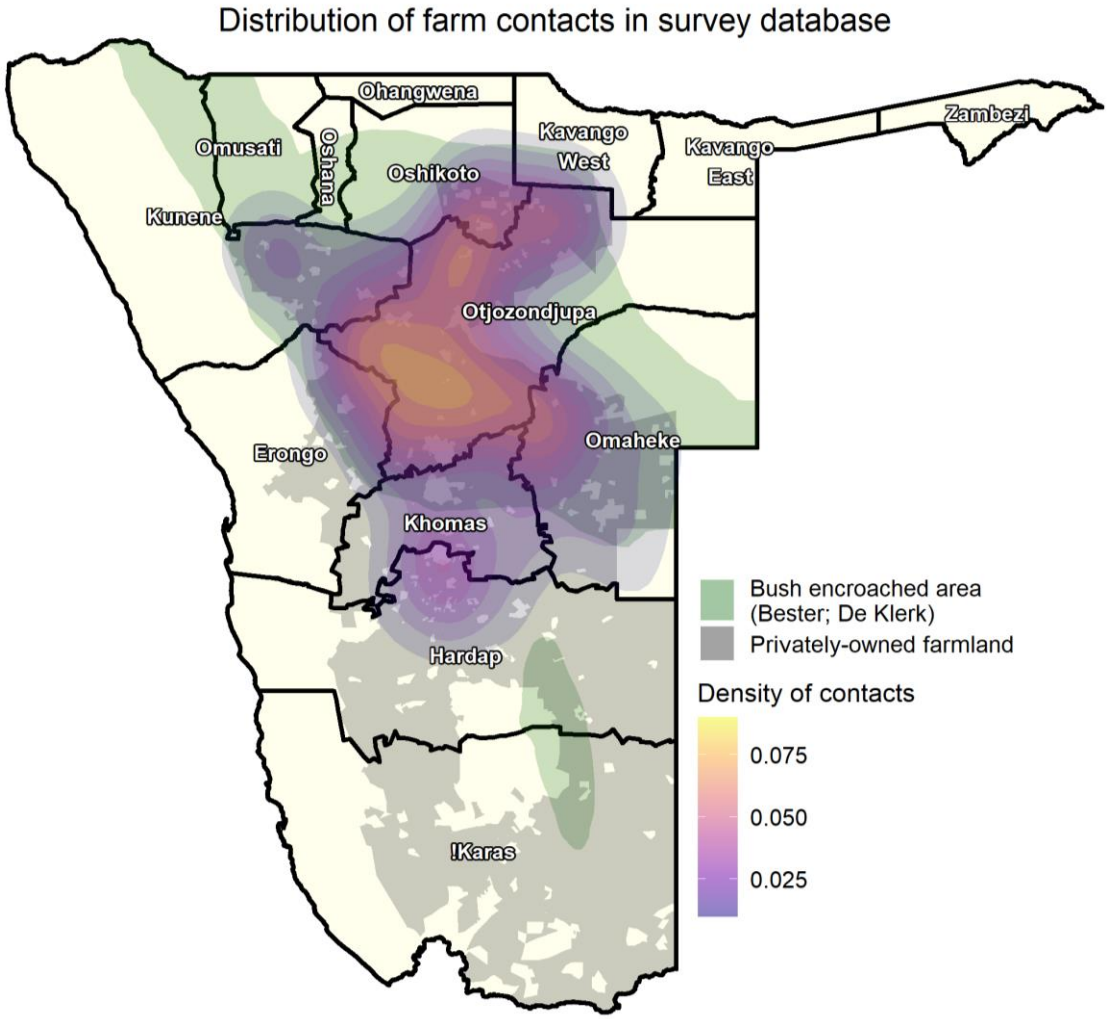

Figure 1: Distribution of commercial farm polygons linked to contacts in the survey database. The bush encroached area is derived from the Bester map.

[1] Not all farmers in the database could be linked to a commercial farm polygon due to several reasons:

i. The GIS layer of farms that was used is outdated. Farms may have been subdivided and/or farm names may have changed since this layer was last updated. In such cases, no unambiguous links could be made.
ii. In the GIS layer used, farm polygons in communal areas (e.g. the Mangetti block in Oshikoto) are neither named nor numbered. Unambiguous links between corresponding farmers and these farm polygons could thus not be made.
iii. Some farmers in the database farm on communal land for which no distinct farm polygons are defined.
iv. For some farmers in the database, the name, contact and affiliation were available, but no information on the farm name and/or number. Therefore, if these farmers did not participate in the survey, they could not be linked to any farm polygon.

2.2 Data Collection

2.2.1 Bottom-Up Data: Farm-Level Survey

Farm-level data collection took place via a structured phone-based survey in April and May 2020. Where possible, potential participants were informed in advance about the survey and encouraged to participate, e.g. through their respective farmers union or FSC group scheme. Phone-based data collection was chosen because i) on-site interviews were considered disproportionately resource-intense and impossible to implement during the Covid-19-related lockdown at the time and ii) data collection via email or web-based questionnaires was ruled out due to a commonly very low response rate.

The target number of farm-level datasets/farmers interviewed was 300 [2]. Three enumerators carried out the phone-based interviews and concurrent digital data entry via EpiCollect 5 (https://five.epicollect.net/), a free mobile data gathering platform initially developed for epidemiological data collection. A single interview took about 20 min. The questionnaires aim to collect farm-level data on the extent and nature of farm-level BCBU operations as well as corresponding farm employment and financial support services (see Annex A3 for the survey questionnaire).

Note that the farmers with available contacts *do not constitute a representative sample* of all commercial/resettlement farmers in Namibia. The latter would be ideal to determine representative statistics with regards to BCBU at the national level but would require access to the contact data of all commercial/resettlement farmers in the country. In the present case, the farmer contact database was compiled based on opportunity sampling, i.e. identification of contacts as available/accessible and, among these contacts, participation by everyone who would be available and willing to participate in the survey. Since this was the only practical approach, it must be expected that there is a considerable sampling bias towards i) farmers who are affected by bush encroachment and who do practice/are interested in BCBU; ii) FSC-certified charcoal producers, since many contacts were identified via the FSC group schemes; and iii) commercial/resettlement farms located in the areas presumably affected most by bush encroachment. Corresponding survey results, therefore, cannot simply be extrapolated to the entire national commercial/resettlement farming population without major assumptions which aim to account for that bias. For reproducibility of results, throughout the report we aim to indicate all assumptions made during data analysis.

A total of 407 commercial/resettlement farmers were contacted in line with the phone-based survey. Of these, 212 participated in the farm-level survey [3], corresponding to a response rate of 52%. The remainder was either not reachable or decided not to participate in the survey.

The surveyed sample of 212 respondents is linked to 213 farm-level records, since one respondent is owner of two separate farms and accordingly provided two different farm-level records. The 213 farm-level records consist of the following respondent categories:

- Ownership/farming system
    - 138 (65%) are commercial farmers on free/-leasehold land.
    - 35 (16%) are emerging commercial / resettlement farmers.
    - 24 (11%) are communal farmers.
    - 16 (8%) farm on government farms. In the present case, this essentially refers to the Mangetti block in Oshikoto Region.

[2] This was set based on calculations of minimum random sample sizes. For an assumed total population of 10,000 commercial/resettlement farmers, the minimum sample size for a confidence interval of ± 5% at 90% confidence would be 266. However, note that the sample used is not a representative random sample, so confidence levels could not be determined.

[3] If these 212 farmers constituted a representative sample from an assumed total population of 10,000, this would be sufficient to derive representative statistics for a ± 5% confidence interval at 85% confidence. However, as the sample is not representative in the present case, the confidence level could not be determined.

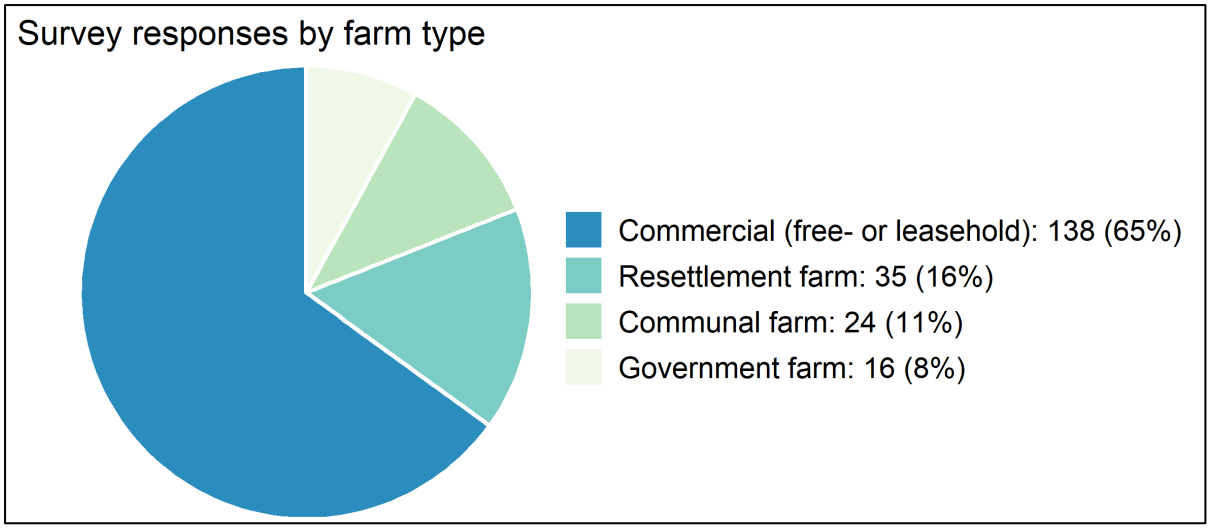

Figure 2: Survey responses by farm type.

- Bush Control and Biomass Utilization
  - 132 (62%) reported that they did bush control activities in 2019.
  - 26 (12%) indicated that they did aftercare/follow-up treatment in 2019 of areas previously bush-thinned areas.
  - 74 (35%) are FSC-certified charcoal producers.
  - 51 (24%) indicated that they produced animal feed from encroacher bush in 2019, predominantly for own use.

Table 2: Basic survey response figures disaggregated by farm type.

Farm type	# of records	Average farm area (ha)	# Done bush control in 2019	Average area bush-thinned (ha) *	# doing aftercare in 2019	# produced bush feed in 2019	# FSC-certified
Commercial (free- or leasehold)	138	5,363	100	480 *	17	42	69
Resettlement farm	35	1,909	22	109 *	5	6	5
Communal farm	24	4,096 [4]	10	29 *	4	3	0
Government farm	16	547	0	NA	0	0	0

* Note that the average bush-thinned area only refers to farms where bush control took place.

- Spatial distribution
  - Of the 213 farm-level records, two thirds (144 records; 68%) could be unambiguously linked to one or more commercial farm polygon(s) [5], see Figure 3.

[4] The communal farmers participating in the survey were mainly from the communal areas in Omaheke and Otjozondjupa. Accordingly, the reported farm areas (and the resulting average) are unlikely to refer to exclusive ownership/access and are thus associated with a high uncertainty.

[5] Note that various commercial farmers own more than one farms. Often, these are adjacent, thus effectively forming one large farm unit. In total, 184 farm polygons were linked to 144 survey participants.

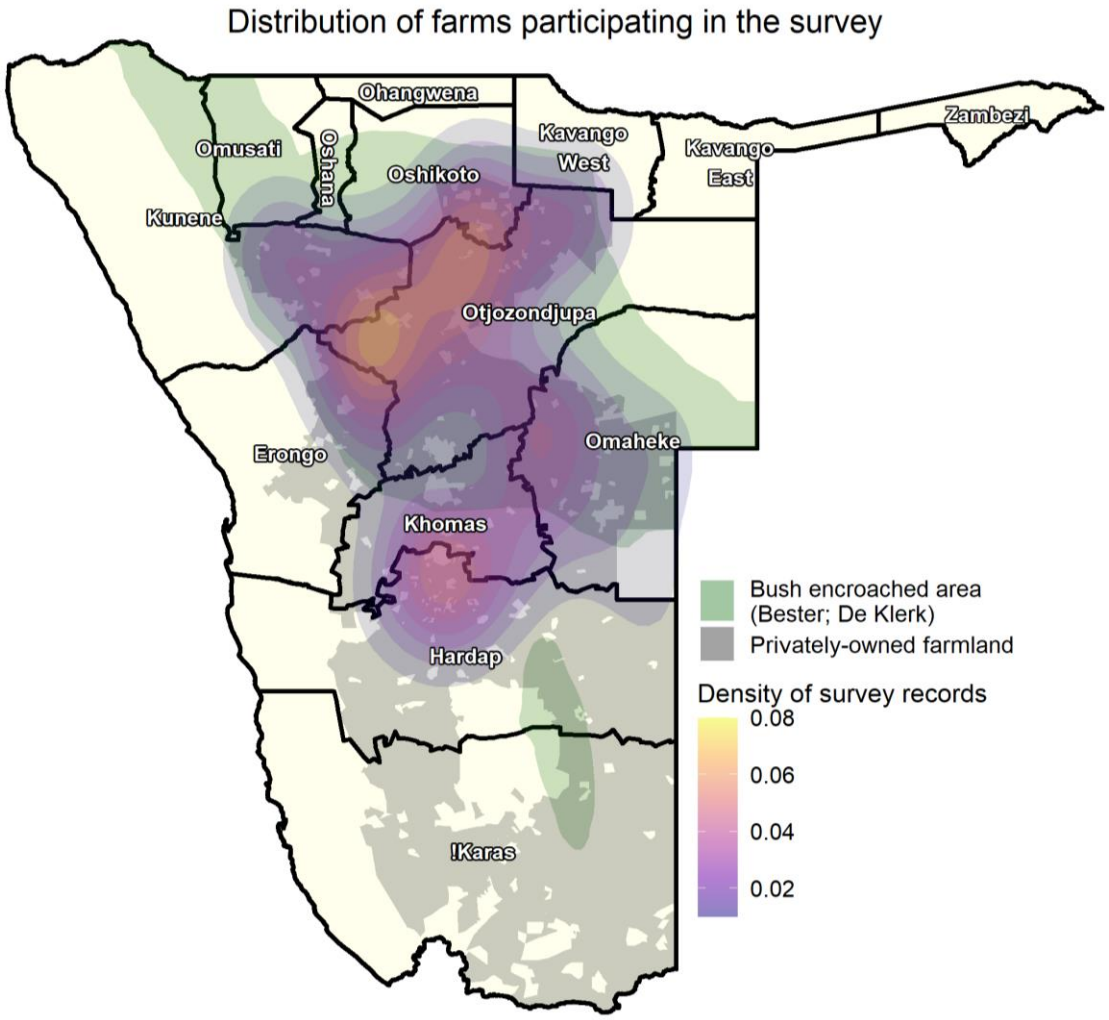

Figure 3: Distribution of farms participating in the survey. Note that the map does not depict the density of all surveyed farms, since some survey records could not be unambiguously linked to a farm polygon.

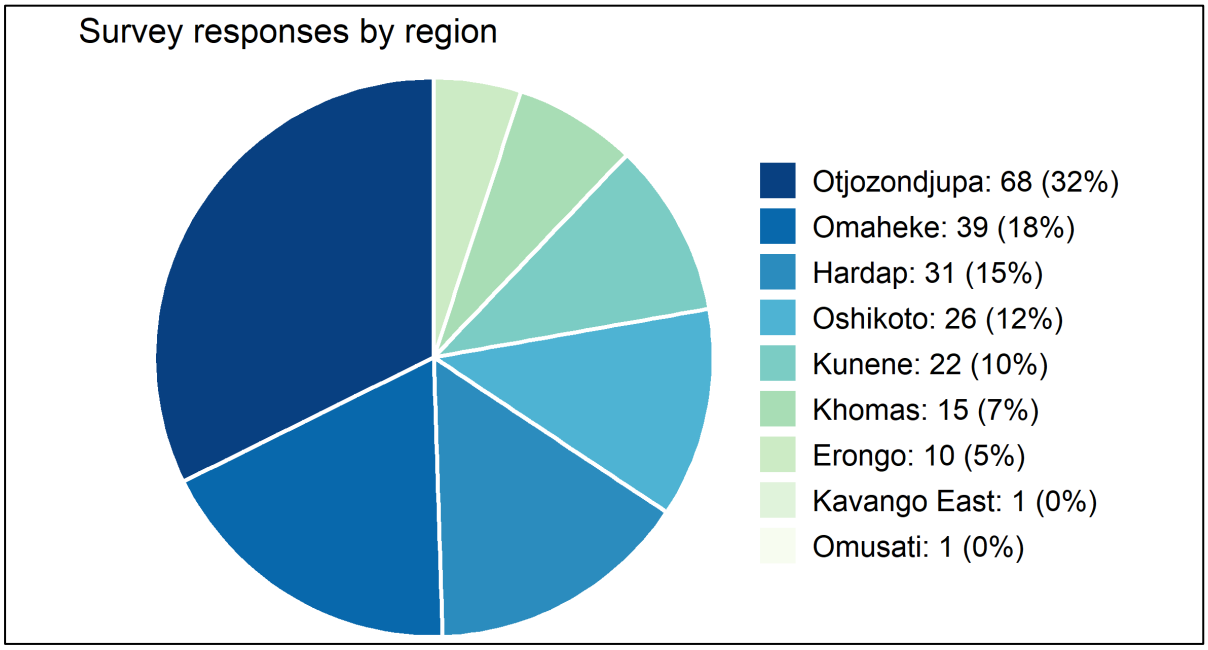

Figure 4: Survey responses by region.

2.2.2 Top-Down Data

Top-down data was collected by requesting corresponding datasets and through key informant interviews. The following datasets were requested and where available and useful - used to determine/estimate indicator values:

- NSA Trade Statistics, annual aggregation, all available from 2004 until 2019:
    - Wood charcoal exports (commodity codes 440200 and 440290)
    - Imports of chemicals (commodity code 380893: Herbicides, anti-sprouting products and plant-growth regulators)
    - Lucerne imports (commodity codes 12141000 and 12149000); i.e. animal feed ingredients which could be (partially) replaced by suitable encroacher bush material harvested locally
- Statistics from MEFT DoF permit system
- Statistics from MEFT DEA environmental clearance certificate system
- NCA:
    - Membership
    - Charcoal production estimates
    - Charcoal export figures as reported by NCA-associated processors
    - Employment figures as reported by NCA-associated processors (2020 survey by NSA)
- FSC: Registered farms and their areas as reported by FSC group scheme managers
- Private sector:
    - Data on area treated and biomass harvested from service providers for mechanized bush control
    - Data on area treated and chemicals sold by service providers for chemical bush control
- Financial service providers: Data on financial support products tailored to the bush biomass sector
- Research institutions: Data on past, ongoing and planned research activities with regards to BCBU

2.3 Survey Database and Data Analysis

A local relational database was set up using PostgreSQL to systematically capture all contacts possibly relevant in line with the DAS M&E System, their links to the respective sector indicator(s) and the contact/farm-level records as well as the stakeholder engagement activities. The local database was accessed and manipulated through a custom-developed interactive local frontend based on R Shiny.

All quantitative data collected was brought into tabular format using Excel or the R Software Environment for Statistical Computing ("R"). R was used for statistical analysis of the farm-level survey data as well as production of corresponding graphs and maps.

Excel was used to collate and analyze third-party/top-down data and to produce corresponding graphs. All assumptions and formulas used for indicator value calculation are contained in this spreadsheet, which can be used for further annual updates.

Considerations and assumptions made in line with analysis of data of individual indicators are discussed for each indicator as applicable in section 3.

3 Results

This section presents the survey results for the different indicators. Where applicable, the both the top-down and bottom-up estimates for a given indicator are presented and compared. Where available, indicator values are presented as timeseries for the period 2010 until 2019. Note that many indicator values are estimates based on assumptions. Where applicable, all underlying assumptions are described to ensure reproducibility of results.

Some assumptions were used uniformly throughout the report. These refer to the number of farms by farming system and were used in line with bottom-up estimates derived through the extrapolation of the farm-level survey findings to the national level.

Commercial farmland is estimated to cover close to 40 million ha and includes freehold farms as well as resettlement and government research farms. The Ministry of Land Reform had listed more than 12,000 commercial farm units between 2012 and 2017, of which about 7,500 are listed as farms and about 4,900 as farm portions (Namibia Statistics Agency, 2018). For the purpose of this report, we assumed that there are 6,000 privately-owned commercial farms, since some (often adjacent) farms/farm portions are owned by the same person. As the total estimated area of privately-owned commercial farms is about 34 million ha (Namibia Statistics Agency, 2018), this corresponds to an average farm size of about 5,700 ha, which is in good agreement with the average farm size as indicated by commercial farmers participating in the farm-level survey. We further assumed that there are 2,000 resettlement farms. As the total estimated area of government resettlement farms is about 3 million ha (Namibia Statistics Agency, 2018), this corresponds to an average farm size of resettlement farms of 1,500 ha.

With regards to communal farms, only very rough assumptions were made since the corresponding sample size is very low. Based on the average indication of farm sizes (assumed to refer to farming communities/villages), we assumed the number of corresponding communal farming units as 10,000.

In general, for each farming system, we assumed that roughly half of the above farms are situated in areas affected by bush encroachment.

The section is structured according to the DAS indicator framework output areas.

3.1 Bush Control Activities

3.1.1 Area Affected by Bush Encroachment

The estimates of the total area affected by bush encroachment have changed significantly over time. Figure 5 depicts the commonly cited estimates, which suggest a rather steep linear increase over time. Note that the major part of this increase is to be attributed to changes in estimation methodology and scope rather than to the actual expansion of bush encroachment. The latter is generally assumed to occur at a growth rate on the order of 3% per annum.

The first estimate of 17.5 million ha by Bester (1998/1999) refers to the commercial farming sector north of Rehoboth. The second estimate by De Klerk (2004) of 26 million ha includes communal areas. The latest systematic estimate by SAIEA (2016) includes the entire country and amounts to 45 million ha, i.e. slightly more than half of Namibia's land area.

Note that, at the national level, the term 'bush encroachment' refers to a wide variety of phenomena related to woody encroachment by different encroacher species at varying intensities. Therefore, the actual total affected area depends on the definition of bush encroachment applied in a given context. The most densely encroached areas occur in the areas which on average receive between 350 and 500 mm of annual rainfall. For more detailed information on bush encroachment, refer to De Klerk (2004).

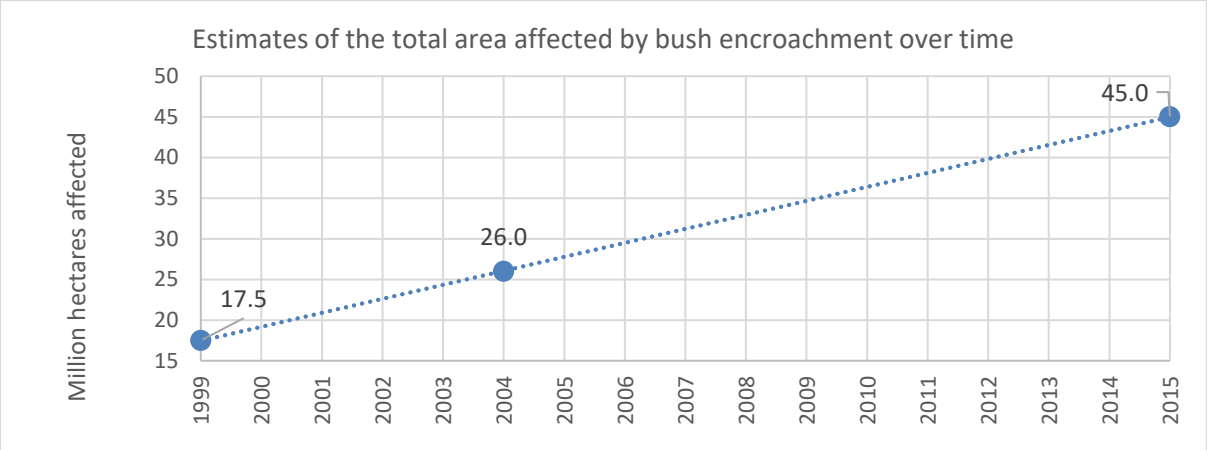

Figure 5: Estimated total area affected by bush encroachment over time as estimated by Bester (1998/1999), De Klerk (2004) and SAIEA (2016).

In agreement with the most recent bush encroachment map developed by SAIEA in 2016, the survey results suggest that bush encroachment actually affects more than the area originally depicted in the Bester map (Bester, 1998/1999), including most of Khomas Region, the southern parts of Omaheke Region as well as the northern parts of Hardap Region. Note, however, that it *cannot* be concluded from the survey results that areas without survey points (all communal areas; !Karas Region) are not affected by bush encroachment, since the surveyed sample is spatially limited and by no means representative for the entire country.

3.1.2 Area under Bush Control

A realistic estimate of the total area under bush control is an important indicator to obtain an idea of i) the extent to which bush encroachment is combatted and where the annual bush control efforts stand in comparison to the (assumed) annual bush growth; and ii) the overall magnitude of the environmental and economic impacts of bush control. Since the intensity and impacts of bush control strongly depend on the method applied, this indicator is being captured by bush control method (De-bushing Advisory Service, 2015). Major bush control methods considered are manual/semi-mechanized harvesting, mechanized tree felling/harvesting and chemical bush control. Bush control through biological means (e.g. deployment of large herds of browsers) or fire are also possible, but were found to be both scarce and hardly quantifiable, since no corresponding commercial service providers exist.

3.1.2.1 MANUAL/SEMI-MECHANIZED BUSH CONTROL

Manual and semi-mechanized bush control methods refer to labor-intensive conventional harvesting methods which do not aim to remove all bushes, but are applied rather selectively, most prominently in line with charcoal production.

Manual/semi-mechanized bush control: Top-down estimate based on charcoal production figures

This estimate is derived from the national charcoal production figures. Since virtually all charcoal is exported, these are assumed to be the same as the charcoal export figures recorded by customs and reported by the Namibia Statistics Agency (NSA)[6]. Based on the assumption that all bush control in line with charcoal production is based on either manual (majority) or semi-mechanized harvesting, the area de-bushed for charcoal production can then be estimated based on an average yield factor per hectare.

[6] Except for 2019, where some 20,000 tons of uncertified charcoal were estimated to be produced but not exported due to saturation of the South African market.

Table 3: Estimated wood biomass yields per area and species (De Klerk, 2004, p. 64) and corresponding charcoal production rates per hectare based on the above assumptions.

Area	Species	Suitable wood biomass (t/ha)	Harvested biomass (t/ha)	Charcoal (t/ha)
Outjo	*Colophospermum mopane*	17.952	9.0	1.80
Outjo	*Terminalia prunioides*	8.214	4.1	0.82
Otjiwarongo	*Acacia mellifera*	13.208	6.6	1.32
Tsumeb	*Terminalia prunioides*	5.724	2.9	0.57
			Average	**1.13**

The amount of suitable wood biomass for charcoal production per hectare for different species and areas was compiled by De Klerk (2004), see Table 3. To estimate an average charcoal yield factor per hectare, we used the arithmetic mean of these values, assuming an average harvesting rate of 50% and a conversion factor from wood biomass to charcoal of 5:1 [7]. The resulting assumed average charcoal yield amounts to 1.13 t/ha. This is consistent with the results of the farm-level survey, for which the average charcoal yield was 1.07 t/ha (again assuming that all charcoal was produced in line with manual/semi-mechanized harvesting).

To estimate the annual area under bush control for charcoal production, the annual charcoal production figures were divided by this factor. In addition, another 20% were added to the resulting area to account for manual/semi-mechanized bush-thinning in line with firewood, bushfeed and other manual small-scale clearing (e.g. for fences, buildings, gardens or firebreaks). The resulting area estimates are provided in Table 4 and Figure 6.

Table 4: Annual estimates of area under bush control through manual/semi-mechanized harvesting based on charcoal production figures.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Charcoal produced (t)	114,447	83,172	84,910	100,492	109,527	119,297	117,682	124,599	139,327	208,320
Area Charcoal (ha)	101,510	73,770	75,311	89,132	97,145	105,811	104,379	110,514	123,577	184,771
Area Other (ha)	20,302	14,754	15,062	17,826	19,429	21,162	20,876	22,103	24,715	36,954
Area Total (ha)	**122,382**	**89,094**	**90,944**	**107,529**	**117,144**	**127,544**	**125,824**	**133,187**	**148,863**	**222,295**

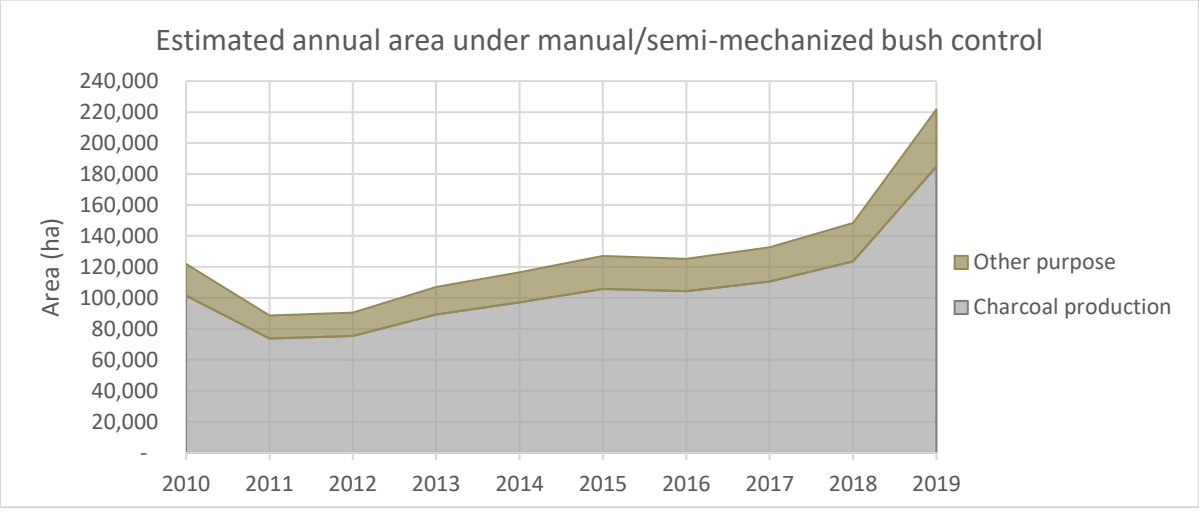

Figure 6: Estimated annual area under manual/semi-mechanized bush control, derived from charcoal production figures (sources: NSA, NCA).

[7] I.e. 5 t of woody biomass yield 1 t of charcoal. This is the generally assumed rate for traditional charcoal burning techniques as predominantly applied in Namibia.

Manual/semi-mechanized bush control: Bottom-up estimate from farm-level survey

Out of the 213 farm-level records, 117 indicated that manual and/or semi-mechanized bush control was done in 2019. Out of these 117, 86 were from commercial farms where an average area of 391 ha was treated; 21 from resettlement farms, where an average area of 99 ha was treated; and 10 from communal farms, where an average of 29 ha was treated. In total, an area of 8,798 ha was reported as under manual or semi-mechanized bush control in 2019 by the survey respondents.

Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 5. We estimated the total number of commercial farms at 6,000, the total number of resettlement farms at 2,000 and the total number of communal farms at 10,000, respectively. The extrapolation factor takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 25% intensity (i.e. another factor of 0.25, which yields a total of 0.5 x 0.25 = 0.125). The latter assumption is made because of the overrepresentation of charcoal producers in the sample, who rely heavily on manual/semi-mechanized bush control. The resulting estimate amounts to more than 240,000 ha under manual/semi-mechanized bush control in 2019, which is in good agreement with the above top-down estimate of 220,000 ha. Translated into commercial farm numbers, this estimate would mean that an average of 400 ha were bush-thinned manually/semi-mechanized on about 450 commercial farms in 2019 and an average of 100 ha on about 300 resettlement farms.

Table 5: Bottom-up estimate of area under manual/semi-mechanized bush control in 2019 based on extrapolation of farm-level survey results.

Manual/semi-mechanized bush control bush control 2019 – Bottom-up survey estimate							
Farm type	Total # of respon-dents	# of active respon-dents	% of respon-dents	Average area treated (ha)	Extra-polation factor	Assumed total pop.	Assumed total area (ha)
Commercial farms	138	86	62%	391	0.125	6,000	182,783
Resettlement farms	35	21	60%	99	0.25	2,000	29,800
Communal farms	24	10	42%	29	0.25	10,000	29,792
Total							242,374

3.1.2.2 CHEMICAL BUSH CONTROL

Chemical bush control refers to the application of root-, foliar- or stem-absorbent arboricides with the main intent to destroy the encroacher bushes and not necessarily to harvest and utilize the bush biomass. There are both solid and liquid arboricides available, which both can be applied selectively (i.e. to individual plants) or rather indiscriminately (e.g. by aerial application from aircrafts).

While indiscriminate chemical bush control is generally discouraged, selective application of chemicals is considered by many as inevitable, particularly in the context of aftercare, i.e. to control regrowth of encroacher bush on already bush-thinned areas. Large-scale (on the order of 1,000 hectares and more) chemical bush control constitutes a major investment and is considered hardly affordable to most full-time commercial farmers who do not have additional income to their farming operations.

Chemical bush control: Top-down estimate based on primary data from service providers

There is a very small number of commercial service providers and outlets in Namibia who offer chemical bush control services in form of aerial spraying or hand application and who further sell arboricides. Based on their data, the potential area chemically de-bushed was estimated for the years 2015 until 2019. In addition to the area chemically de-bushed by these service providers, we estimated the potential area chemically treated based on their arboricides sales figures. For the latter, we assumed that half of the arboricides sold were used for selective de-bushing and the other half for aftercare. Further, we assumed that liquid arboricides are applied at 2.5 l/ha [8] and solids at 8.3 kg/ha [9] in line with selective application and aftercare.

For 2019, these estimates yield a potential area under chemical bush control of about 67,000 ha and a potential area under chemical follow-up treatment of slightly more than 20,000 ha.

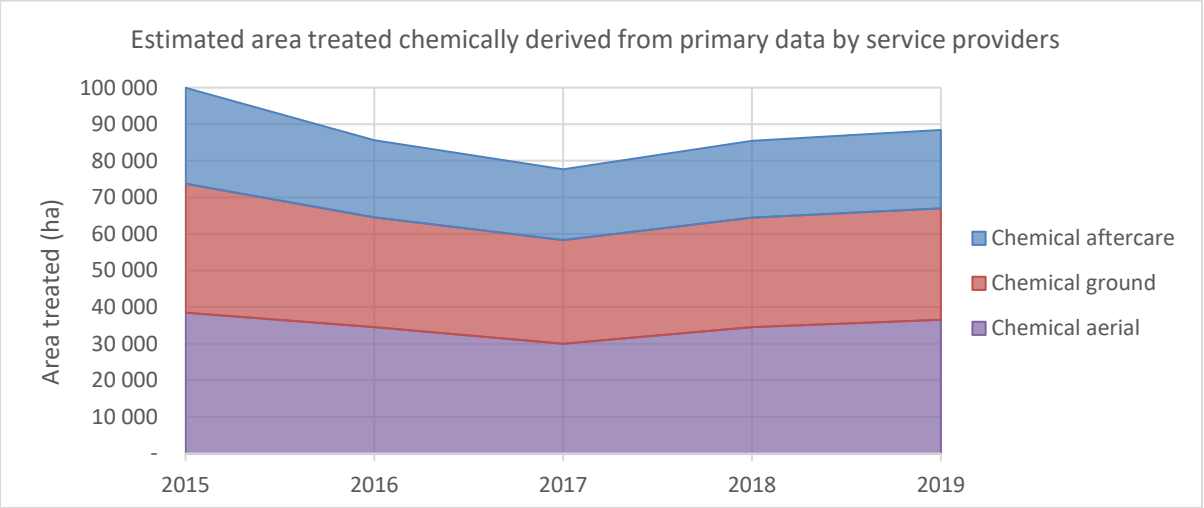

Figure 7: Estimated area under chemical bush control derived from primary data by service providers, 2015 – 2019.

Importantly, note that, according to the chemical bush control service providers, the amount per hectare of chemicals required for aerial application is lower than the amounts required for targeted ground application.

Chemical bush control: Top-down estimate based on chemicals imported and sold

Based on the amount of chemicals imported as recorded in the NSA Trade Statistics, we estimated the potential area under chemical bush control. However, note that these estimates are based on several assumptions that are hard to verify. First, there is no dedicated commodity code for arboricides in the trade statistics. The only

[8] Direct communication from service provider.

[9] Based on the average usage recommendations per individual bush for different solid substances, assuming average number of bush (ETTE units) to be removed per hectare at 6,900. The latter figure was determined based on average ETTE/ha as indicated in the 2015 biomass resource assessment (Smit, de Klerk, Schneider, & van Eck, 2015), assuming an average retention of 4,000 ETTE/ha.

likely relevant commodity category is "380893: Herbicides, anti-sprouting products and plant-growth regulators". Most of the corresponding imports come from South Africa or China, other sources are virtually insignificant. We assumed that 50% of the imports under this category are arboricides and that, of these, 75% are solid and 25% are liquid. The resulting amounts are consistent with the reported amounts of arboricides sold by the corresponding service providers in the country. We further assumed that, on average, 50% of the solid arboricides are used for indiscriminate de-bushing (i.e. aerial application) and, of the overall remainder, 50% for selective bush thinning and 50% for selective aftercare. Finally, as above, we calculated the potentially treated area for each of these categories based on the assumption that liquid arboricides are applied at 2.5 l/ha and solids at 8.3 kg/ha in line with selective application and aftercare. The resulting estimates are visualized in Figure 8.

For 2019, these estimates yield a potential area under chemical bush control of close to 50,000 ha and a potential area under chemical follow-up treatment of slightly more than 20,000 ha.

Rothauge (2014) estimated that, in 2014, the arboricides sold in that year equated to an area of 84,000 hectares if applied selectively. The present estimate for 2014 yields a potential area of only 38,000 hectares for a mix of selective and indiscriminate application. However, note that the amounts needed per hectare assumed here are much higher (by a factor 2.5 for liquids and a factor 5 for solids) than the ones assumed by Rothauge.

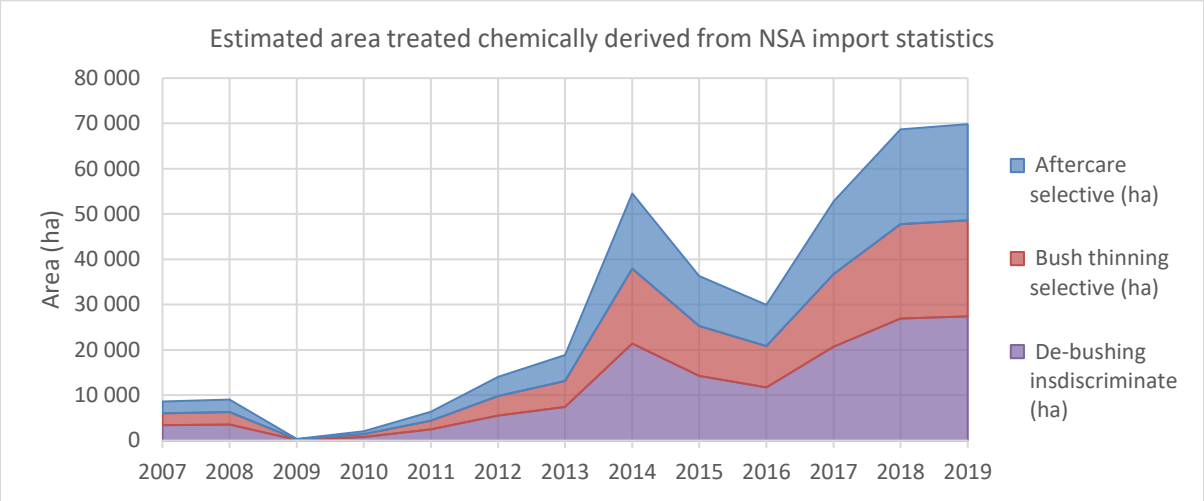

Figure 8: Estimated potential area under chemical treatment derived from NSA import statistics, 2007 – 2019.

Chemical bush control: Bottom-up estimate from farm-level survey

Out of the 213 farm-level records, 21 indicated that chemical bush control was done in 2019. Out of these 21, 17 were from commercial farms where an average area of 500 ha was chemically treated and 4 from resettlement farms, where an average area of 75 ha was chemically treated. In total, an area of 8,798 ha was reported as chemically bush-thinned in 2019 by the survey respondents.

Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 6. We estimated the total number of commercial farms at 6,000 and the total number of resettlement farms at 2,000, respectively. The extrapolation factor takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 50% intensity (i.e. another factor of 0.5, which yields a total of 0.5 x 0.5 = 0.25). The resulting estimate amounts to close to 100,000 ha under chemical bush control in 2019, which is in significantly higher than the above estimates of about 67,000 ha and 50,000 ha, respectively. Translated into farm numbers, this bottom up estimate would mean that an average of 500 ha were chemically treated on about 180 commercial farms in 2019 and an average of 76 ha on about 60 resettlement farms.

Table 6: Bottom-up estimate of area under chemical bush control in 2019 based on extrapolation of farm-level survey results.

Chemical bush control 2019 – Bottom-up survey estimate							
Farm type	Total # of respon-dents	# of active respon-dents	% of respon-dents	Average area treated (ha)	Extra-polation factor	Assumed total pop.	Assumed total area (ha)
Commercial farms	138	17	12	500	0.25	6,000	92,337
Resettlement farms	35	4	11	76	0.25	2,000	4,329
Total							96,666

3.1.2.3 MECHANIZED BUSH CONTROL

Mechanized bush control refers to the utilization of large-scale machinery such as excavators, bulldozers and tractors equipped with special equipment for destroying and possibly harvesting encroacher bush.

Mechanized bush control: Top-down estimate based on figures from service providers

As for chemical bush control services, there is a small number of commercial service providers who offer mechanized bush control services in Namibia. The annual estimates presented in Figure 9 are based on figures provided by these service providers for the last 10 years. In addition, an annual 5,000 hectares were assumed to be under mechanized bush control by individual farmers, e.g. through chain-based techniques. For 2019, it is estimated that roughly 17,000 hectares were under mechanized bush control.

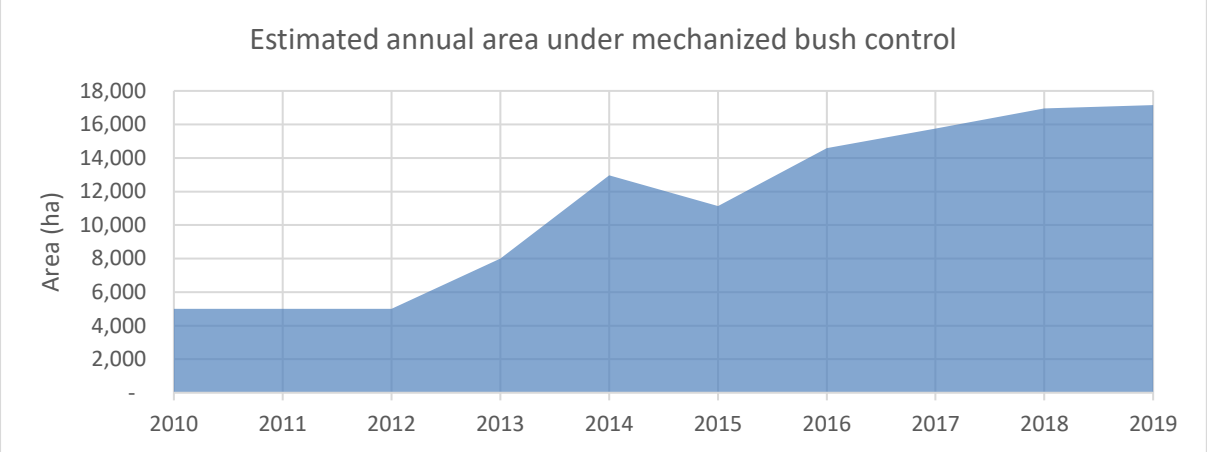

Figure 9: Estimated annual area under mechanized bush control based on information provided by commercial service providers.

Mechanized bush control: Bottom-up estimate from farm-level survey

Out of the 213 farm-level records, 14 indicated that mechanized bush control was done in 2019. All of these were commercial farmers, with an average area of 389 ha mechanically bush-thinned. In total, an area of 5,446 ha was reported as mechanically bush-thinned in 2019 by the survey respondents.

Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 7. We estimated the total number of commercial farms at 6,000. The extrapolation factor of 0.25 takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 50% intensity (i.e. another factor of 0.5, which yields a total of 0.5 x 0.5 = 0.25). The resulting estimate amounts to close to 60,000 ha under mechanized bush control in 2019. Translated into farm numbers, this estimate would mean that an average of 390 ha were under mechanized bush control on about 150 commercial farms in 2019.

Table 7: Bottom-up estimate of area under mechanized bush control in 2019 based on extrapolation of farm-level survey results.

Mechanized bush control 2019 – Bottom-up survey estimate							
Farm type	Total # of respon-dents	# of active respon-dents	% of respon-dents	Average area treated (ha)	Extra-polation factor	Assumed total pop.	Assumed total area (ha)
Commercial farms	138	14	10%	389.29	0.25	6,000	59,239

This is significantly higher than the estimate based on activity figures from service providers, suggesting that either i) the data from service providers is incomplete; ii) mechanical de-bushing activities by individual farmers based on relatively low-tech approaches (e.g. chain-based) are actually more widespread than assumed; or iii) the surveyed sample has a strong bias towards farmers applying mechanized bush control techniques.

3.1.3 Bush Control Follow-Up Treatment/Aftercare

Aftercare, i.e. the follow-up treatment of already bush-controlled areas, is considered a crucial requirement for sustained success of bush control operations. Based on trade statistics on chemicals imported, we estimated the potential area under chemical aftercare at about 20,000 ha in 2019 (see subsection 3.1.2.2 above). Here, we derive an additional estimate from the farm-level survey data.

Out of the 213 farm-level records, 26 indicated that aftercare of previously bush-thinned areas was done in 2019. Out of these 26, 17 were from commercial farms where an average area of 425 ha was treated; 5 from resettlement farms, where an average area of 10 ha was treated; and 4 from communal farms, where an average of 5 ha was treated. In total, an area of close to 7,300 ha was reported as follow-up treated in 2019 by the survey respondents.

Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 7. We estimated the total number of commercial farms at 6,000. The extrapolation factor of 0.25 takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 50% intensity (i.e. another factor of 0.5, which yields a total of 0.5 x 0.5 = 0.25). The resulting estimate amounts to slightly more than 80,000 ha under aftercare in 2019. Of these, an estimated 21,000 ha are treated chemically (see section 0).

Table 8: Bottom-up estimate of area after-treated in 2019 based on extrapolation of farm-level survey results.

Aftercare 2019 – Bottom-up survey estimate							
Farm type	Total # of respon-dents	# of active respon-dents	% of respon-dents	Average area treated (ha)	Extra-polation factor	Assumed total pop.	Assumed total area (ha)
Commercial farms	138	17	12%	425	0.25	6,000	78,587
Resettlement farms	35	5	14%	10	0.25	2,000	700
Communal farms	24	4	17%	5	0.25	10,000	1,944
Total	197	26					81,231

3.1.4 Permits and Environmental Clearance Certificates

3.1.4.1 HARVESTING PERMITS ISSUED BY DOF

A harvesting permit from the Directorate of Forestry (DoF) is required by law for any tree cutting and/or harvesting of wood in an area greater than 15 hectares per annum (MAWF/MET, 2016). Accordingly, statistics derived from harvesting permits issued by DoF could provide an additional estimate on the area under bush

control as well as the amounts of bush biomass harvested [10]. Such statistics were requested for the reference year 2019 from DoF. However, such statistics were not readily available for the following reasons:

- DoF permits are paper-based and archived only locally in permit books. DoF officials compile quarterly statistics for their respective office/area by hand.
- There is no standardized reporting format used by all DoF offices. Some offices submit the statistics in text form along with their narrative quarterly reports, whereas others submit them in form of (more easily usable) Excel spreadsheets.
- Levels of disaggregation differ between different DoF offices. Some offices only report bare numbers of permits issued by permit category (e.g. harvesting, transport, marketing, etc.), whereas others also disaggregate by the product category harvested. The latter is of crucial importance to be able to extract meaningful figures with regards to bush control and biomass utilization operations.
- Individual DoF offices submit quarterly permit statistics to the subdivisional level, where they are supposed to be aggregated by hand and then submitted onward to divisional/national level for further aggregation. This process is vulnerable to major reporting gaps and inaccuracies. As a result, the national-level figures are considered patchy and incomplete.
- There is no systematic central archiving of quarterly reports and statistics at DoF head office level in Windhoek. This means that any request for statistics dating back in time (e.g. as for calendar year 2019 in the present case) needs to be directed to all the relevant local DoF offices.

Given the above, it was not possible to obtain meaningful statistics on bush control and biomass utilization from the DoF permit system. We consider this a major shortcoming, since the forestry permit system constitutes the main mechanism to enforce and monitor the implementation of the Forest Act, i.e. to ensure the sustainable utilization of Namibia's forestry resources. Possible solutions to strengthen the capturing and reporting on permit data were discussed with DoF management and corresponding tools were developed. For further information on these, refer to section **Error! Reference source not found.**.

3.1.4.2 ENVIRONMENTAL CLEARANCE CERTIFICATES

Medium-sized (150 – 5,000 ha) bush harvesting operations require an environmental clearance certificate (ECC) from the Department of Environmental Affairs (DEA). Large-scale (> 5,000 ha) bush harvesting operations in addition require a full environmental impact assessment (EIA) as well as an environmental management plan (EMP). Accordingly, statistics derived from environmental clearance certificates could provide an additional estimate on the area under bush control as well as the amounts of bush biomass harvested in line with medium- to large-scale operations. Such statistics were requested for the reference year 2019 from DEA and were not readily available.

The DEA introduced a digital web-based ECC system in August 2019 (accessible via http://eia.met.gov.na/). Until then, the ECC process was paper-based and only basic statistics were captured in an Excel spreadsheet. The latter did not capture the category (e.g. "bush clearing" for the present case) and the related area of each corresponding project/activity. The only way to extract such statistics retrospectively for 2019 would thus be for MEFT officials to go through the list of projects certified in 2019, identify the relevant ones via their title and then extract the areas from each respective report. There are thus currently no ECC statistics related to bush control available for 2019 and previous years. Fortunately, going forward, this situation can be expected to change. The new digital system is promising and ECC statistics for the year 2020 and onward will likely be available relatively easily (see section **Error! Reference source not found.** for more details).

[10] Such statistics would likely constitute an upper boundary estimate, since a permit issued for a given area/amount does not mean that the corresponding amount is actually harvested.

3.1.5 Bush Control Summary

Summarizing the section on bush control, based on the given assumptions, we estimate that an area of slightly more than 300,000 ha was under a form of bush control in Namibia in 2019 (see Figure 10). Compared to the 2010 estimate, this corresponds to an annual growth rate of more than 6%. Overall, the area under bush control over the last 10 years is estimated at close to 2 million ha (550,000 ha chemical, 110,000 ha mechanized, 1,280,000 ha manual/semi-mechanized).

Our estimate is slightly larger than previous estimates. For example, in 2014, Rothauge estimated that 128,000 ha are being treated annually (Rothauge, 2014). The present estimate for 2014 amounts to about 178,000 ha.

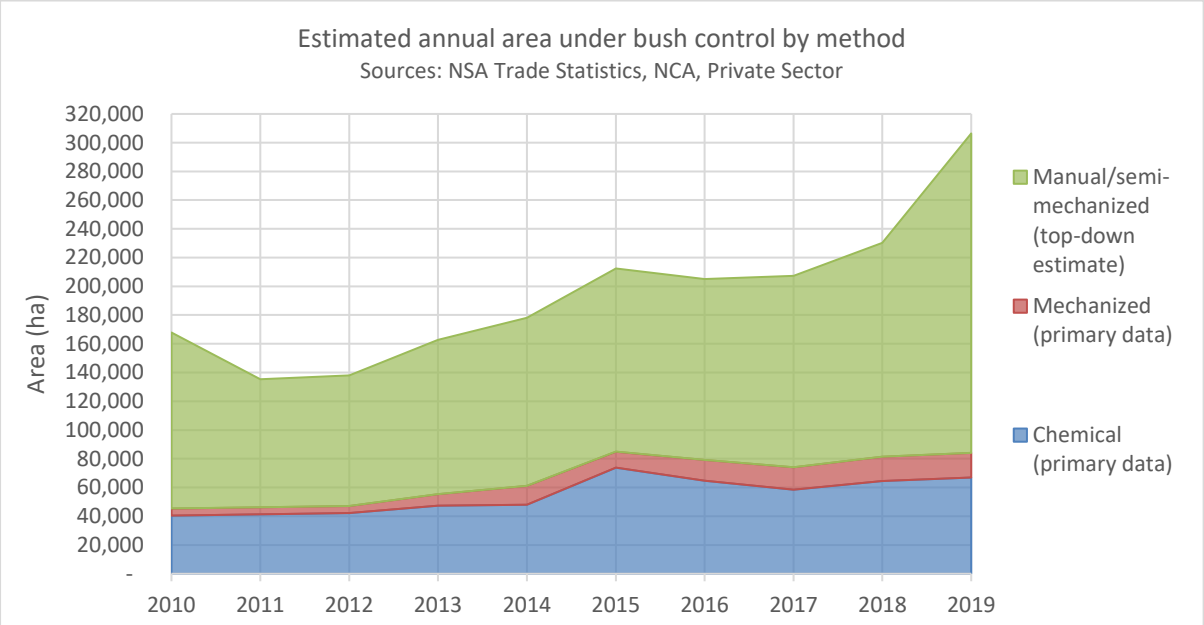

Figure 10: Estimated annual area under bush control by method, 2010 – 2019.

Note that we consider this our best estimate based on a combination of primary data from sector stakeholders and top down estimates as well as a range of rough assumptions. For 2019, the minimum estimates combined for the different bush control methods amount to about 290,000 ha in total, whereas the maximum estimates amount to close to 400,000 ha in total (see Figure 12).

Figure 11 below visualizes the different estimates for each major bush control method based on the different estimation approaches applied. The bottom-up estimate based on farm-level survey data consistently constitutes the highest estimate, possibly suggesting that the sampling bias is even slightly stronger than assumed. Overall, however, there are no major outliers, suggesting that the different estimation methods yield consistent and plausible results.

It is important to note that the bush control intensity (i.e. the amount of bush biomass removed) can vary significantly between the different bush control methods and purposes. For example, for many farmers producing charcoal the primary aim is biomass utilization whereas bush control is only a secondary target. While for manual/semi-mechanized bush control, a harvesting rate of 50% of the harvestable biomass was assumed, this rate is assumed to be much higher for mechanized and chemical bush control. In case of the latter, in turn, the bush biomass is not necessarily being harvested and further utilized. For thorough interpretation, the indicator “are under bush control” thus would need to be considered in conjunction with figures on the bush biomass destroyed/harvested.

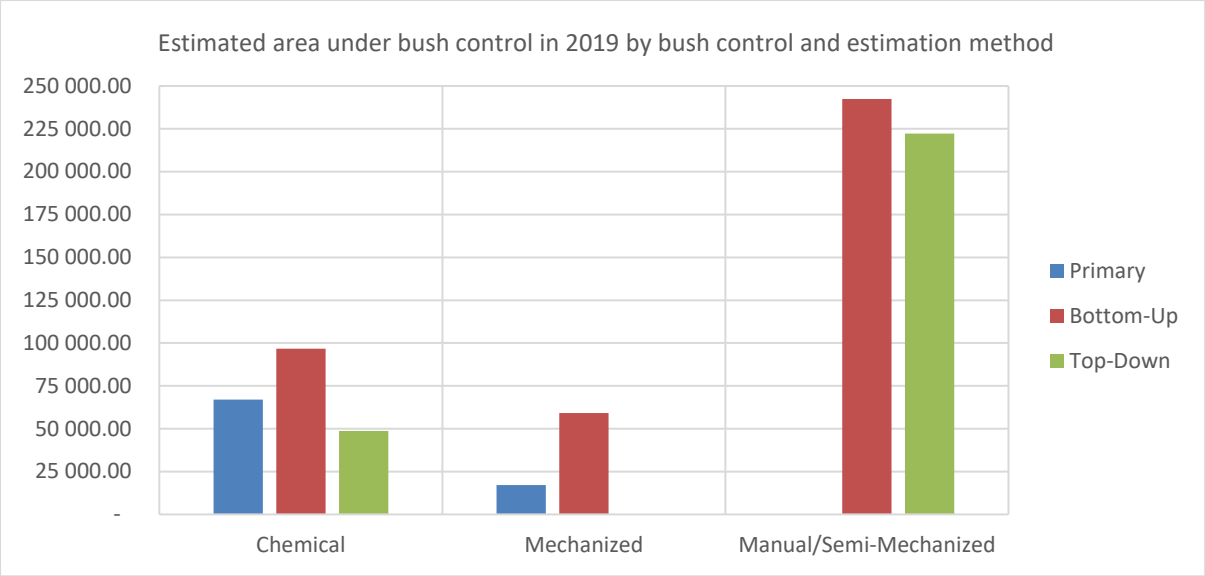

Figure 11: Different estimates of the area under bush control in 2019 by bush control method.

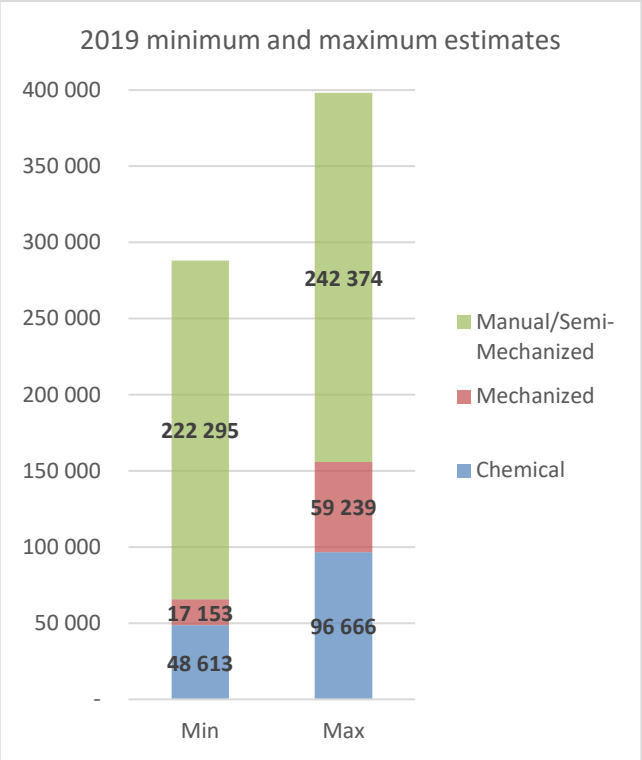

Figure 12: Combinations of the respective minimum and maximum estimates of area under bush control per bush control method for 2019.

3.2 Market and Business Development

3.2.1 Charcoal

3.2.1.1 CHARCOAL EXPORTS

The charcoal industry is the largest and best developed subsector of the Namibian bush biomass sector. Virtually all charcoal produced in Namibia is exported, making Namibia one of the largest global exporters of wood charcoal, consistently ranging among the top ten exporters during the past decade. Annual charcoal exports as recorded in official Namibian trade statistics have almost quadrupled over the past 15 years and stood at 185,820 tons worth 662.5 million N$ in 2019 (see Figure 13 and Figure 14).

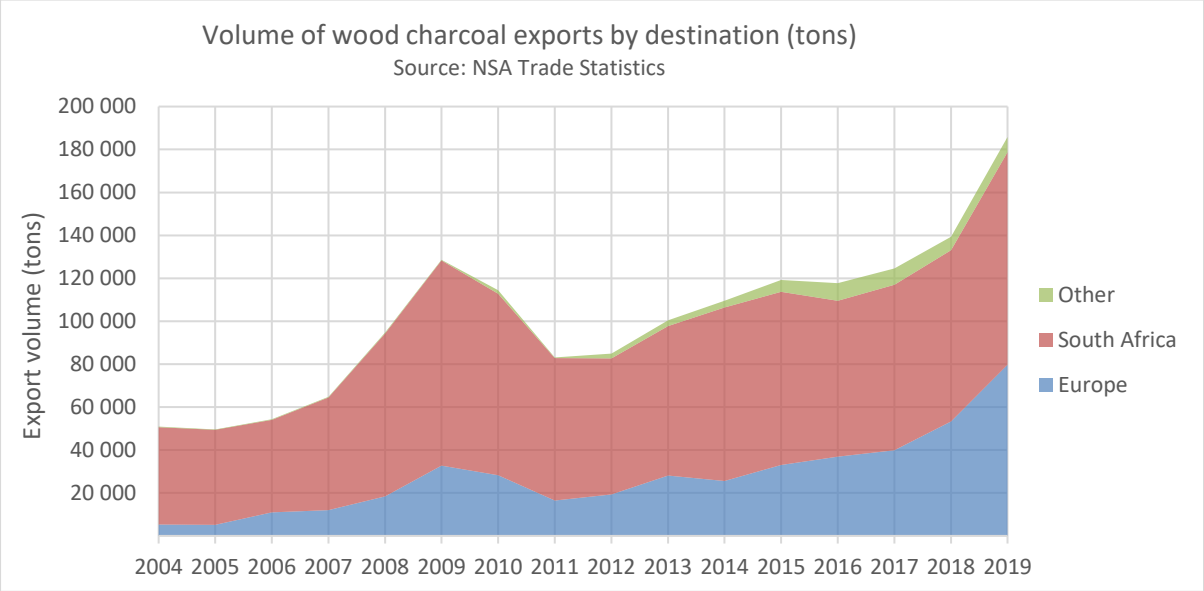

Figure 13: Annual volume of wood charcoal exports by destination 2004 - 2019. Source: NSA Trade Statistics.

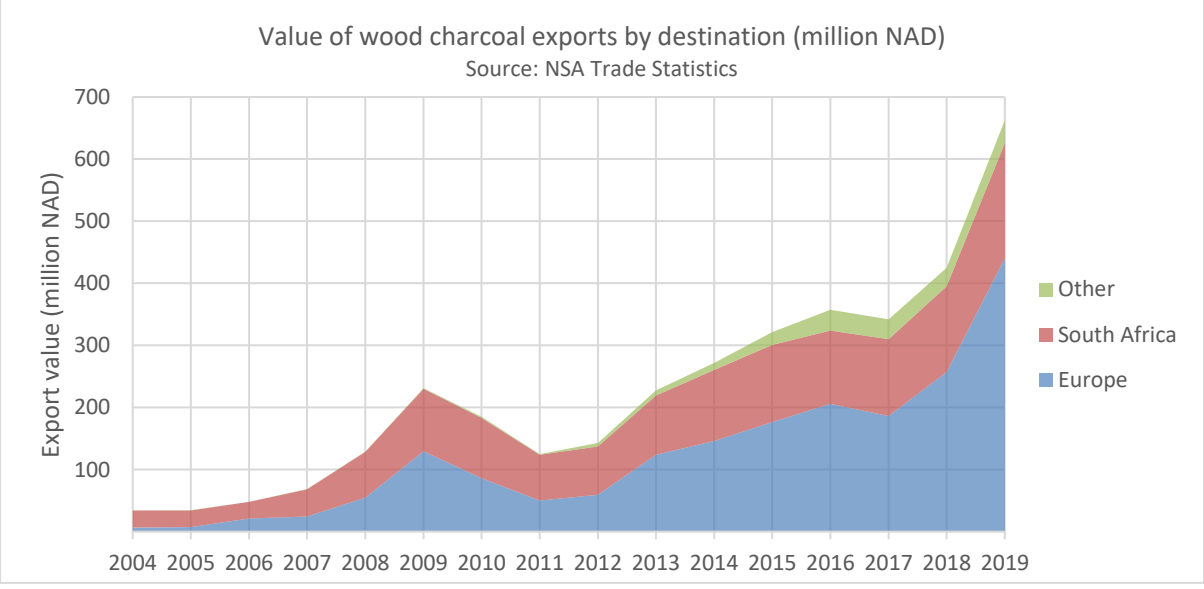

Figure 14: Annual value of wood charcoal exports by destination 2004 - 2019. Source: NSA Trade Statistics.

The major export destinations for Namibian charcoal are South Africa and Europe. Interestingly, the 2019 wood charcoal exports to Europe accounted for two thirds (66%) of the total export value (left side of Figure 15), but only for 43% of the total export volume. Conversely, the value of the 2019 wood charcoal exports to South Africa is about 28% of the total, whereas the volume is about 53% (see Figure 15). However, note that these figures are not fully consistent with estimates by the Namibia Charcoal Association (NCA), which estimates that a larger

share of about 55-60% (i.e. at least 100,000 tons) of Namibian charcoal were exported directly to Europe in 2019.

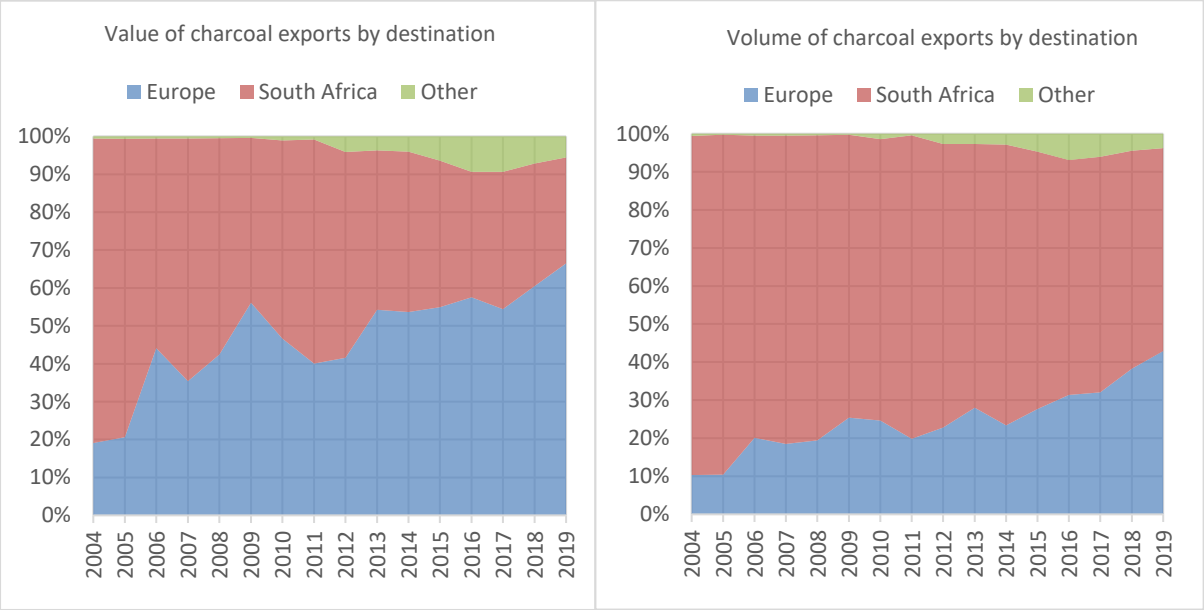

Figure 15: Relative value and volume of charcoal exports by destination 2004 – 2019. Source: NSA Trade Statistics.

This inverse relationship between volume and value suggests that significantly higher prices can be achieved from exports to Europe than to South Africa and/or that the quality of wood charcoal exported to Europe is higher than the one exported to South Africa. According to the 2019 NSA trade statistics, a ton of charcoal exported to South Africa was on average worth 1,872 N$, whereas the value for export to Europe was almost three times higher with 5,522 N$ per ton. The reason is that i) mainly the raw product is exported to South Africa, where further value addition takes place and ii) most of the FSC-certified wood charcoal is directly exported to Europe and elsewhere, whereas the major recipient of non-certified wood charcoal is South Africa.

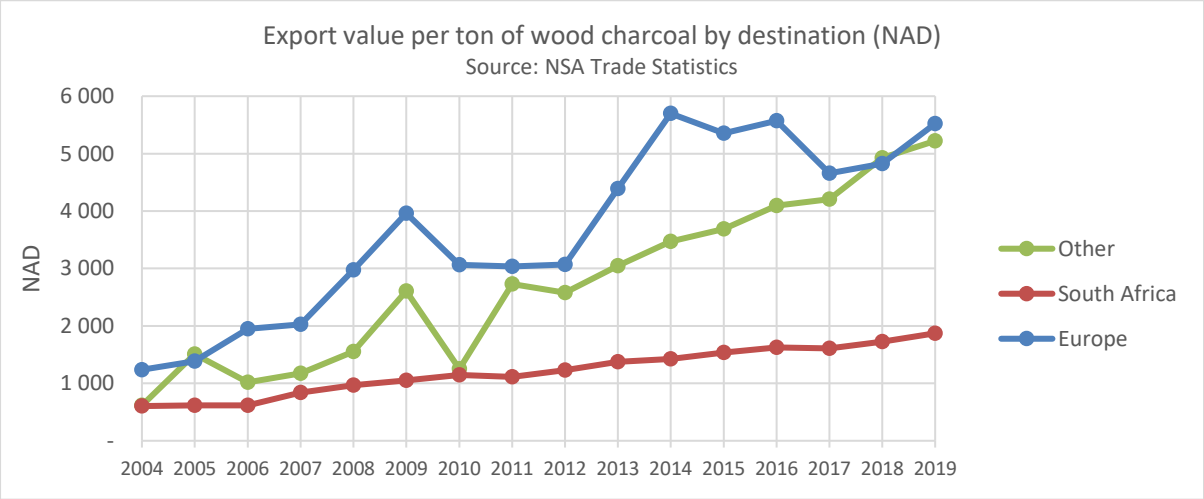

Figure 16: Export value per ton of wood charcoal per destination 2004 – 2019. Source: NSA Trade Statistics.

Going forward, all the above figures suggest that there is potential for further growth in the charcoal subsector. In his 2014 baseline assessment of the Namibian bush biomass sector, Rothauge (2014) stated that "the demand for charcoal, internationally, far exceeds the supply", suggesting that there is no threat of saturation in the global market. It seems, however, that this situation is about to change. According to various charcoal processors, 2020 has been a year of oversupply and they could not buy all the charcoal which had been produced on farms. The next sector indicator update for 2020 may thus show a stagnation/plunge in charcoal export figures. An

important question is whether this is a longer-term development or rather a short-lived exception related to the Covid-19 pandemic and related global uncertainties.

3.2.1.2 FSC CERTIFICATION

The total FSC-certified area was determined based on the sizes and entry dates of individual farms and farms that are part of FSC group schemes. All these farms are commercial farms which were certified for bush biomass production (mainly charcoal, but also products such as bushbloks). As of mid-2020, the certified area amounted to almost 1.6 million ha, corresponding to 270 farms. Note that, given the recent rapid increase in certifications, the actual number by the end of 2020 is likely to be still higher than that.

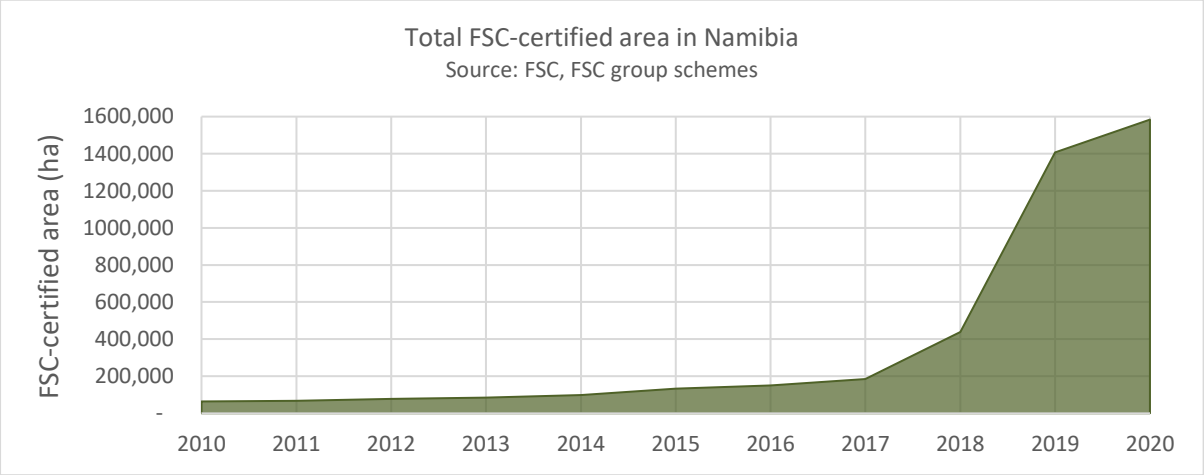

Figure 17: Total FSC-certified area in Namibia 2010 - 2020. Sources: FSC, FSC group schemes.

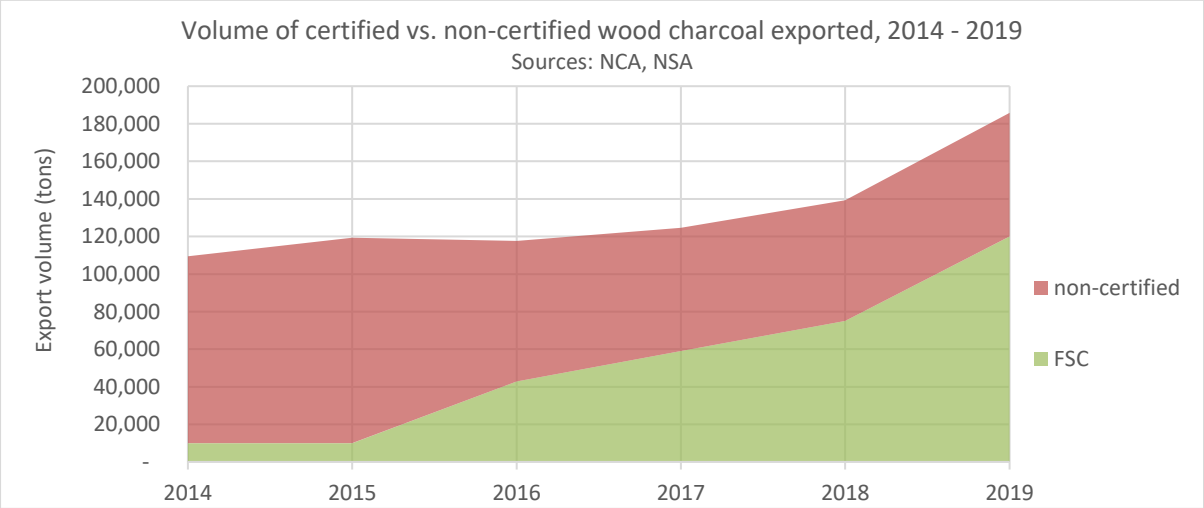

Figure 18: Annual estimated export volumes of FSC-certified vs. uncertified wood charcoal, 2014-2019. Sources: NCA, NSA Trade Statistics.

The estimated amount of FSC-certified charcoal vs. uncertified charcoal is provided in Figure 18. The development between 2014 and 2019 shows a clear trend towards more FSC-certified charcoal. In 2019, FSC-certified charcoal made up about two thirds (65%) of charcoal exports, whereas about one third (35%) was uncertified.

Figure 19 visualizes the spatial distribution of FSC-certified farms in Namibia. However, note that the farms depicted only include the ones which participated in the farm-level survey (69 out of the 270+ FSC-certified farms in Namibia as of 2020).

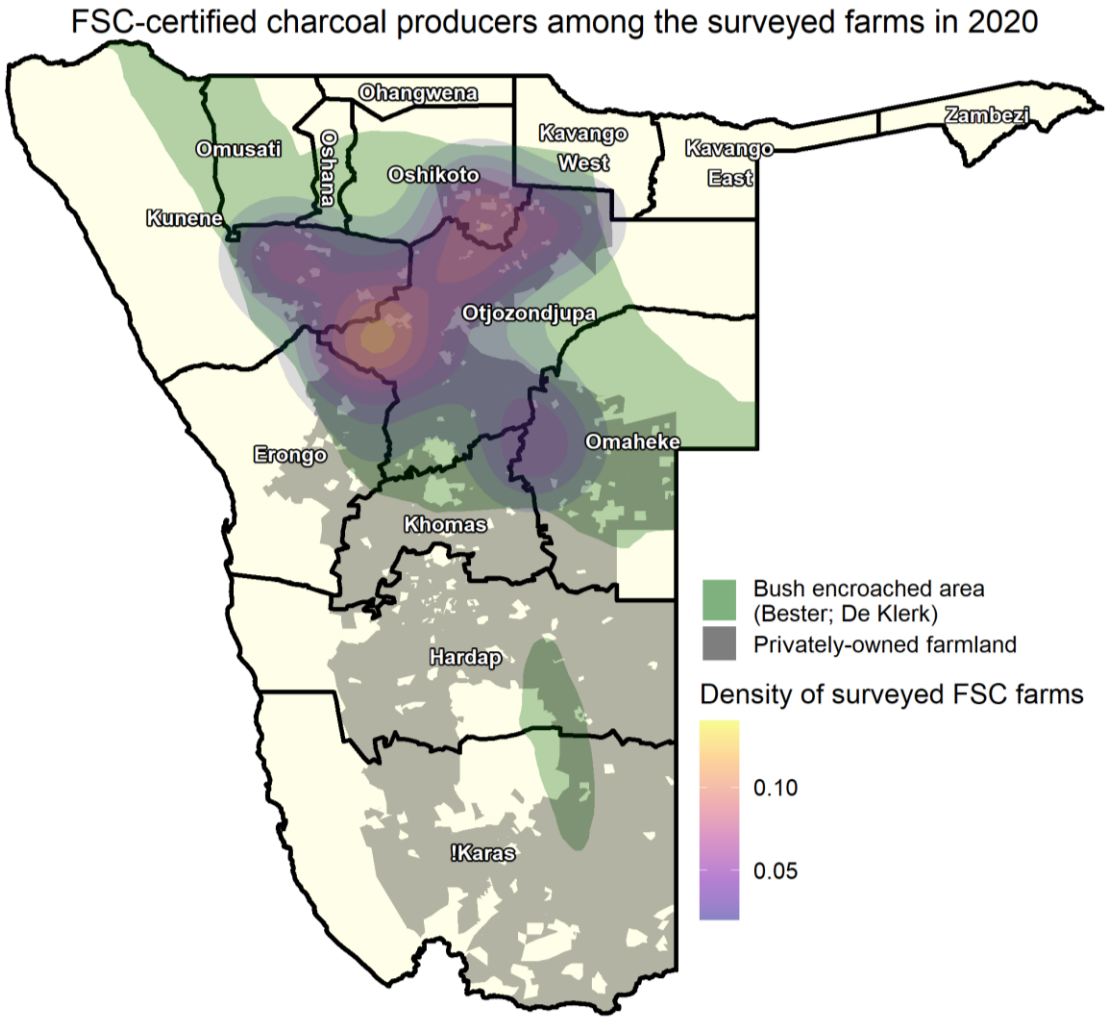

Figure 19: Distribution of FSC-certified charcoal producers surveyed in 2020. Note that the map does not depict all FSC-certified farms in Namibia, but only surveyed FSC-certified farms.

3.2.1.3 NAMIBIA CHARCOAL ASSOCIATION

The charcoal subsector is largely organized under the Namibia Charcoal Association (NCA; formerly known as Namibia Charcoal Producers Association). Since 2016, its membership (mainly individual farmers/charcoal producers) has grown steadily (see Figure 20).

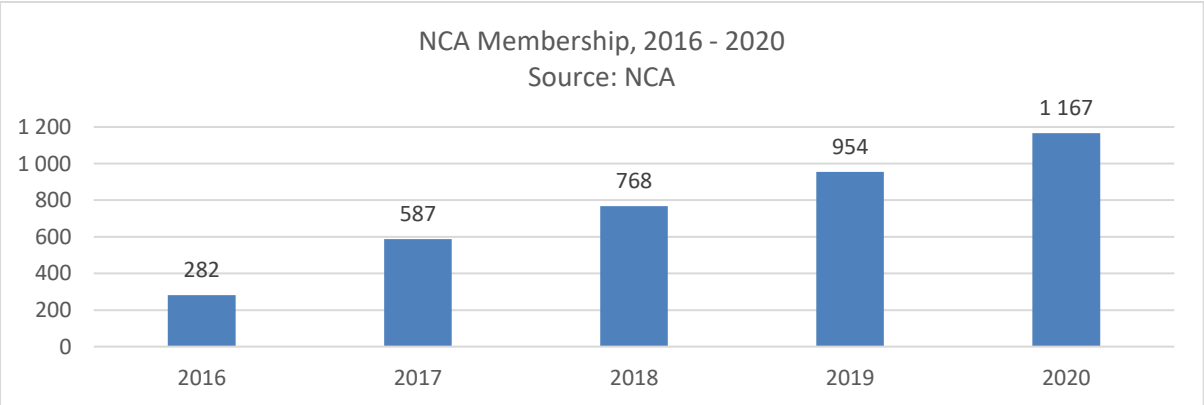

Figure 20: Number of individual NCA members, 2016 – 2020. Source: NCA, August 2020.

Most of the 270 (mid-2020 figure) FSC-certified charcoal producers (i.e. farmers certified for FSC-compliant charcoal production) are also NCA members.

Figure 21 below visualizes the spatial distribution of the surveyed farms with NCA membership. Out of 76 farmers who are NCA member, 70 (92%) indicated that they produced charcoal in 2019 and 69 are also FSC-certified charcoal producers. In turn, among the 137 survey participants who are not NCA members, 12 (9%) indicated that they produced charcoal in 2019 and 5 are FSC-certified charcoal producers.

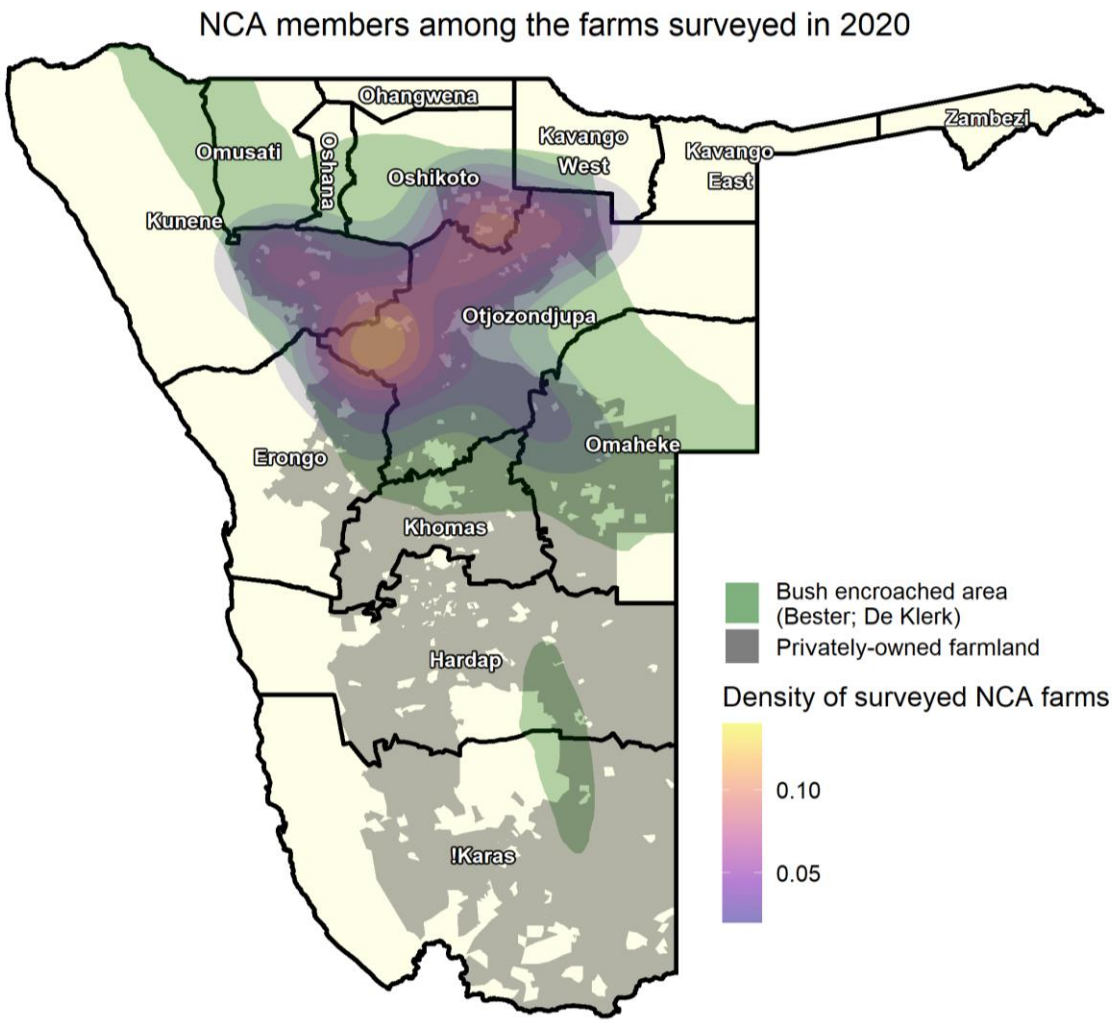

Figure 21: Distribution of NCA members surveyed in 2020. Note that the map does not depict all NCA members in Namibia, but only surveyed NCA members.

Based on the NCA membership figures and the average production figures for FSC-certified and uncertified charcoal, the number of uncertified charcoal producers was estimated at more than 800 in 2019 (see Figure 22). Most of the latter (more than 700) are NCA members. While these figures seem high, note that not every farmer produces charcoal on an annual basis, i.e. the number of farmers producing charcoal in a given year is likely to be significantly lower, particular in case of uncertified charcoal producers.

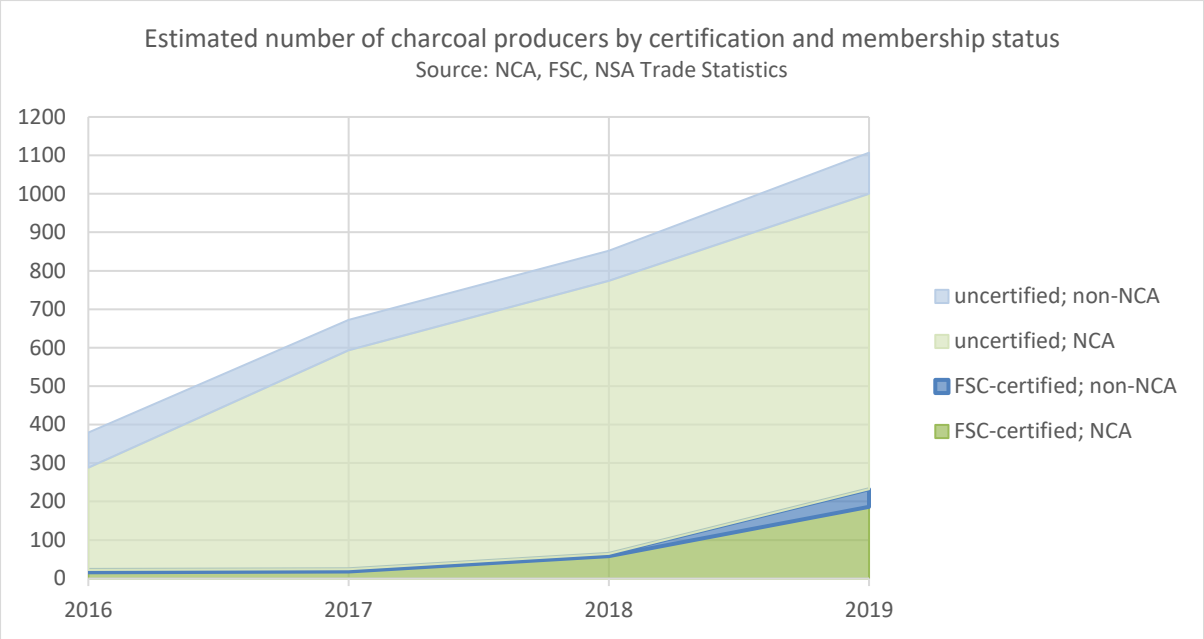

Figure 22: Estimated number of charcoal producers, 2016 - 2019. Sources: NCA, FSC, NSA Trade Statistics.

Concurrently, the number of charcoal processors has also increased steadily (see Figure 23).

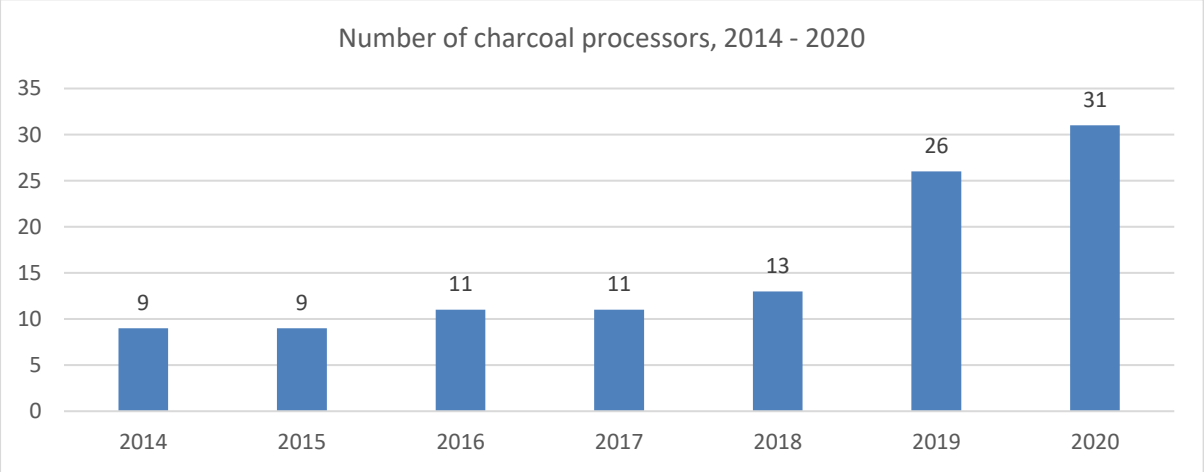

Figure 23: Number of charcoal processors between 2014 and 2020. Source: NCA.

3.2.2 Bush-based Animal Feed

Bush-based animal feed is a promising way of utilizing encroacher bush. In drought years, it seems relatively common that farmers add encroacher bush to their livestock feed, albeit production happens predominantly for own use and hardly in a commercial way thus far.

The need for animal feed in drought years is illustrated by the lucerne imports, which peak in years following poor rainy seasons and saw a sharp increase in the drought year 2019. The average lucerne imports for the years 2013 to 2018 were 7,700 tons worth 22 million per annum and skyrocketed to 60,000 tons worth more than 150 million NAD in 2019. Virtually all lucerne imports originate from South Africa. These figures illustrate that, at least in drought years, bush-based animal feed has a significant commercial potential.

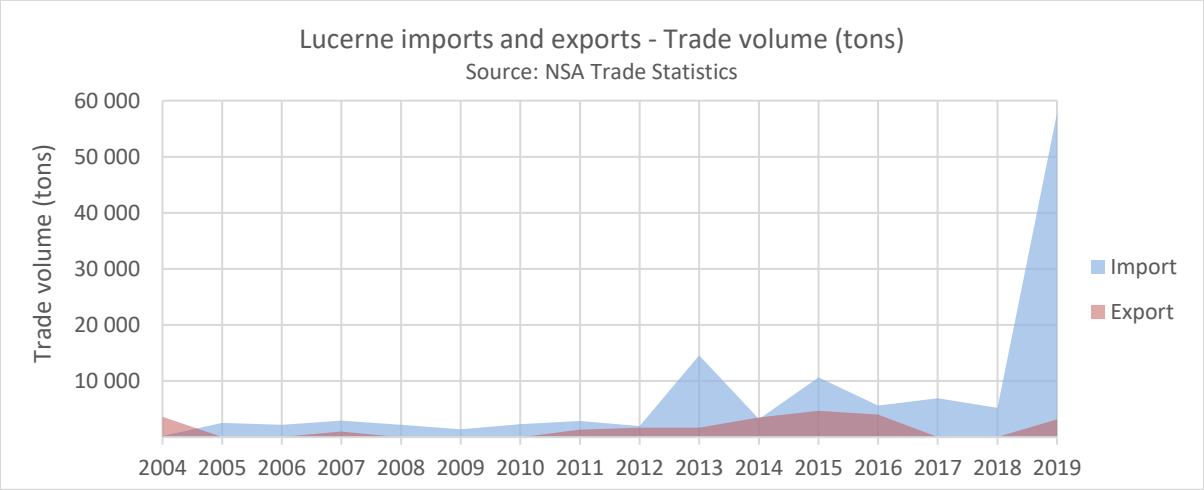

Figure 24: Annual trade volume (tons) for lucerne 2004 - 2019. Source: NSA Trade Statistics.

Bush-based animal feed production: Bottom-up estimate from farm-level survey

Out of the 213 farm-level records, 51 indicated that they produced bush feed in 2019 (see Table 9). In total, an amount of about 7,700 tons of bush feed was produced in 2019 by the survey respondents. Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 9. We estimated the total number of commercial farms at 6,000, the total number of resettlement farms at 2,000 and the total number of communal farms at 10,000, respectively. The extrapolation factor takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 50% intensity (i.e. another factor of 0.5, which yields a total of 0.5 x 0.5 = 0.25). The resulting estimate amounts to slightly more than 100,000 tons of bush feed produced in 2019, predominantly for own use. This seems quite high, but not impossible, given the extreme drought condition in 2019. However, note that particularly the estimates for the resettlement and communal farms are associated with a high uncertainty as the respective sample sizes are very low. Translated into commercial farm numbers, this estimate would mean that an average of 180 tons of bush feed were produced on about 450 commercial farms in 2019.

Table 9: Bottom-up estimate of bush-based animal feed produced in 2019 based on extrapolation of farm-level survey results.

Bush feed production 2019							
Farm type	Number of respondents	Number of active respondents	Percentage among respondents	Average production (t)	Extrapolation factor	Assumed total population	Assumed total amount (t)
Commercial farms	138	42	30%	176	0.25	6,000	80,348
Resettlement farms	35	6	17%	19	0.25	2,000	1,629
Communal farms	24	3	13%	67	0.25	10,000	20,938
Total							102,914

Based on the assumption that a cattle was fed about 6 kg of bush feed daily over a period of 9 months (March to December) in the drought year 2019, the estimated amount of bush feed produced could in theory have sustained between 64,000 (estimate referring to readily-mixed bush feed with 50% bush fibre) and 127,000 (estimate referring to bush fibre only, before mixing 50:50 with other supplements) heads of cattle.

Seven respondents (6 commercial farmers and 1 resettlement farmer) further indicated that they also sold bush feed at prices between 2,000 and 2,200 NAD per ton. In total, about 580 tons of bush feed worth almost 1.3 million NAD were reported as sold by these 7 farmers [11]. Based on the same assumptions as above, extrapolation of these values yields a total estimate of almost 6,500 tons of bush feed being sold in 2019, corresponding to an estimated value of 14 million NAD. Again, given the small sample, these estimated need to be taken with care and are associated with high uncertainties. However, while seeming high, these figures are small compared to the 2019 lucerne import figures (see Figure 24).

Table 10: Bottom-up estimate of bush-based animal feed sold in 2019 based on extrapolation of farm-level survey results.

Bushfeed sales 2019							
Farm type	# of respondents	# of active respondents	Percentage among respondents	Average sold (t)	Extrapolation factor	Assumed total population	Estimated total amount (t)
Commercial farms	138	6	4%	91	0.25	6,000	5,902
Resettlement farms	35	1	3%	38	0.25	2,000	543
Total							6,445

Note that the above estimates can be assumed to be exceptionally high due to the extreme drought conditions in 2019. A 2020 update based on a farm-level survey would thus be expected to yield significantly lower estimates and could serve to consolidate the present estimates and underlying assumptions.

This would be in line with a recent survey in 2020 by Ideal-X Consultants among 86 respondents involved in bush feed production. While most respondents produced bush feed in 2019, most of them discontinued production in 2020. They indicated that the primary aim of bush feed production in 2019 was survival of their livestock rather than income generation.

[11] While the survey respondents were not asked about whether they are registered commercial bushfeed producers, most of the seven farmers who indicated that they sold bushfeed are assumed not to be registered. According to experts in the field of bushfeed, there were only 6 registered bushfeed producers in Namibia in 2019.

3.2.3 Other Bush Biomass Products and Value Chains

Wood chips/pellets for industrial combustion

Wood chips can be used for industrial combustion. Currently, there are only two major users of woodchips in Namibia: Ohorongo Cement and NamBreweries. The annual amount of woodchips produced was estimated based on data provided by their suppliers. For 2019, the estimate of woodchips produced and commercially traded amounts to 34,000 tons.

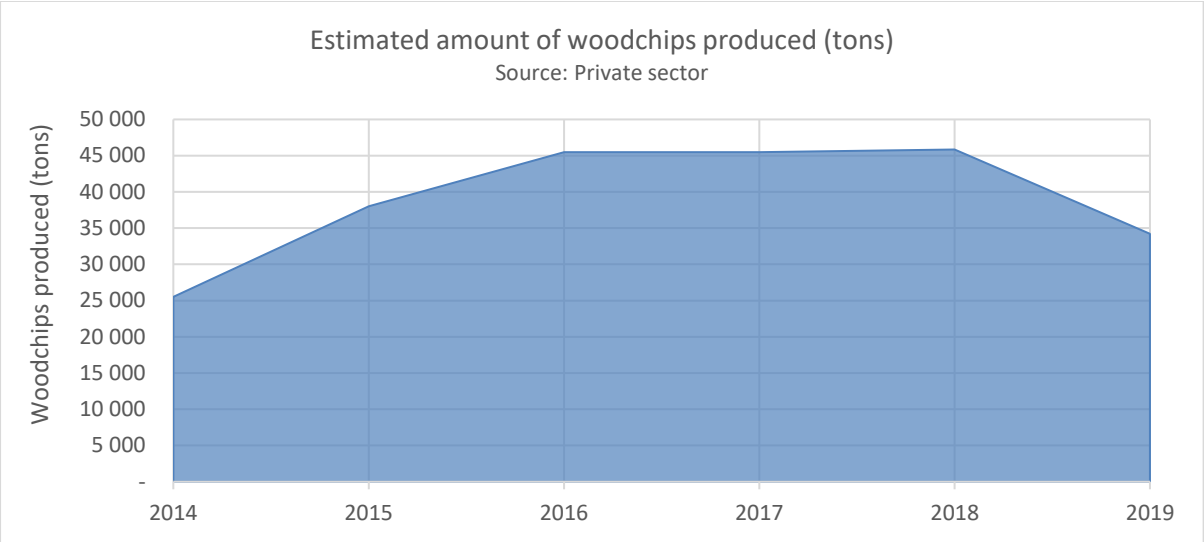

Figure 25: Estimated amount of woodchips produced and commercially traded, 2014-2019. Source: Private sector.

None of the respondents of the farm-level survey reported that they produced or sold any woodchips or -pellets in 2019. Therefore, no estimate on this commodity can be derived from the farm-level survey.

Firewood

Out of the 213 farm-level records, 39 indicated that they produced firewood for own use in 2019 (see Table 11). Since the surveyed sample cannot be considered representative, extrapolation to the national level can only be made based on rough assumptions as presented in Table 11. We estimated the total number of commercial farms at 6,000, the total number of resettlement farms at 2,000 and the total number of communal farms at 10,000, respectively. The extrapolation factor considers that bush encroachment affects roughly half of the farming areas (i.e. factor of 0.5). Other than that, we see no apparent reason why the survey sample should be biased towards the production of firewood from encroacher bush. The resulting overall estimate amounts to slightly more than 120,000 tons of firewood produced from encroacher bush for own use in 2019. This is much lower than the estimate of 440,000 tons of firewood harvested for own consumption cited by Rothauge (2014). However, the latter refers not only to firewood from encroacher bush, but any firewood.

Table 11: Bottom-up estimate of firewood produced from encroacher bush for own use in 2019 based on extrapolation of farm-level survey results.

Firewood production 2019 - own use							
Farm type	# of respondents	# of active respondents	Percentage among respondents	Average production (t)	Extrapolation factor	Assumed total population	Assumed total amount (t)
Commercial farms	138	20	14%	8	0.50	6,000	3,552
Resettlement farms	35	10	29%	18	0.50	2,000	5,115

Communal farms	24	9	38%	60	0.50	10,000	113,116
Total							121,783

In terms of firewood sales, out of the 213 farm-level records, 33 indicated that they produced firewood for sale in 2019 (see Table 12). The resulting overall estimate is based on the same assumptions as above and amounts to slightly more than 50,000 tons of firewood produced from encroacher bush sold in 2019. This is more than the estimate of 45,000 tons of firewood sold formally per year as cited by Rothauge (2014). Note that the estimates for resettlement and communal farms are associated with high uncertainties due to very low sample sizes.

Table 12: Bottom-up estimate of firewood produced from encroacher bush sold in 2019 based on extrapolation of farm-level survey results.

Firewood production 2019 - sale							
Farm type	# of respondents	# of active respondents	Percentage among respondents	Average production (t)	Extrapolation factor	Assumed total population	Assumed total amount (t)
Commercial farms	138	28	20%	71	0.50	6,000	43,109
Resettlement farms	35	3	9%	69	0.50	2,000	5,914
Communal farms	24	2	8%	7	0.50	10,000	2,917
Total							51,940

According to the farm-level survey, average firewood prices per ton range between 900 NAD on resettlement farms (the same value was assumed for communal farms, since no meaningful value was indicated by the corresponding respondents) and 1,400 NAD. Based on these prices, the total value of the bush-based firewood sold in 2019 is estimated at 70 million NAD.

3.3 Employment Creation

3.3.1 Charcoal

The charcoal subsector, being heavily reliant on manual/semi-mechanized harvesting at the farm level, employs most people in the bush biomass sector. The estimated number of employees involved in charcoal production was derived from the overall charcoal production figures. It is assumed that an individual charcoal producer on average produces 3 tons of charcoal per month and on average works 9 months per year. Virtually all the charcoal producers are male. An additional 10% of the resulting figure were assumed to be employed on farm to take care of peripheral work such as sifting, packaging and transport. The latter were assumed to be predominantly women. For 2019, this results in an estimate of about 7,700 males and 770 females being employed in charcoal production.

The estimated number of employees in charcoal processing was based on a recent survey conducted by NCA among all 26 known charcoal processors. For 2019, this survey yielded 716 men and 623 women. For previous years, these figures were reduced by 10% per year, taking into account the growing number of charcoal processors over time (see Figure 23).

Rothauge (2014) estimated that about 5,000 laborers were employed in charcoal production in 2014. The present estimate for 2014 amounts to roughly 5,250 employees, which is in good agreement with the former. Overall, it is estimated that close to 10,000 people were employed in the charcoal subsector in 2019. Of these, an estimated 14% were women.

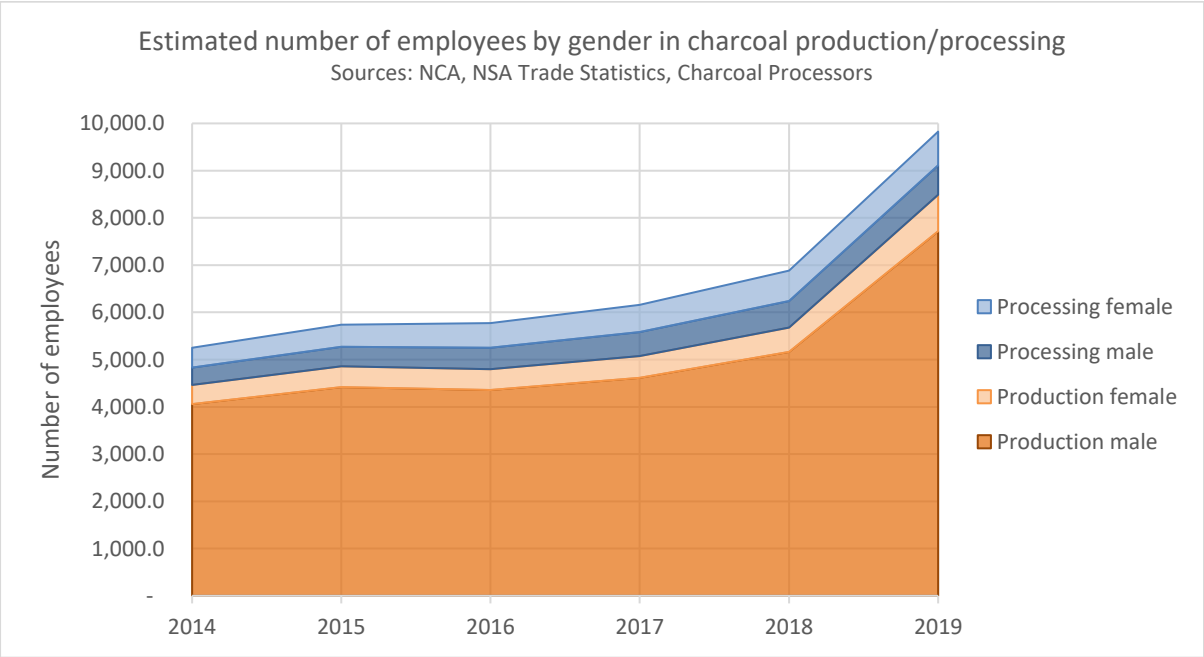

Figure 26: Estimated number of employees in charcoal production and processing 2014 - 2019, disaggregated by gender.

In terms of salary, charcoal production workers are usually paid per ton produced. The amount paid per ton as indicated in the farm-level survey ranged between 300 and 1,000 NAD. The median payment was 850 NAD/ton for FSC-certified producers and 800 NAD/ton for uncertified producers in 2019 [12] . This corresponds to between 40% and 50% of the selling price by charcoal producers. Based on the assumed production figures, for an average

[12] Note

charcoal production worker this equates to an average monthly salary of 2,550 NAD and an annual salary of about 23,000 NAD in 2019.

3.3.2 Other

Bush feed

According to a recent survey on bush feed, farmers who produced bush feed in 2019 on average employed two additional laborers for this work, virtually all of them male. Based on the estimates on bush feed produced in 2019 (see section 3.2.2), roughly 450 commercial farmers engaged in production in 2019. This results in an estimated 900 additional farm-level jobs in 2019 for bush feed production, predominantly for own use. Note that resettlement and communal farms are omitted here, since the reported quantities produced on these farms are much lower than on commercial farms.

According to a recent survey on bush feed, there were 6 registered bush-feed producers in 2019. On average, each of these employs 6 people, resulting in 36 employees with registered bush feed producers in 2019.

In total, this bring the estimate of people employed in bush feed production in 2019 to close to 1,000. However, note that 2019 was an exceptional year in terms of bush feed production. It is thus unlikely that the same number of people will be employed in bush feed production in 2020.

Firewood

It is assumed that most of the cutting of bush-based firewood is done by manual/semi-mechanized means and that a worker can produce on average 15 tons of firewood per month (in line with the previous assumption that a charcoal worker has to cut 15 tons of wood to produce 3 tons of charcoal per month at a commonly applied wood: charcoal conversion rate of 5:1). Assuming that he works on average 9 months per year, this means a production of 135 tons per year. For the 2019 estimate of more than 50,000 tons of bush-based firewood sold, this equates to roughly 380 employees for commercial firewood production in 2019. It is assumed that virtually all of these are male.

BCBU-related service providers

There is a limited number of companies providing commercial BCBU-related services such as bush-thinning or biomass harvesting. Their number of employees over time was derived from estimates on the respective number of employees and the year of inception. For 2019, the estimated total number of employees is 121.

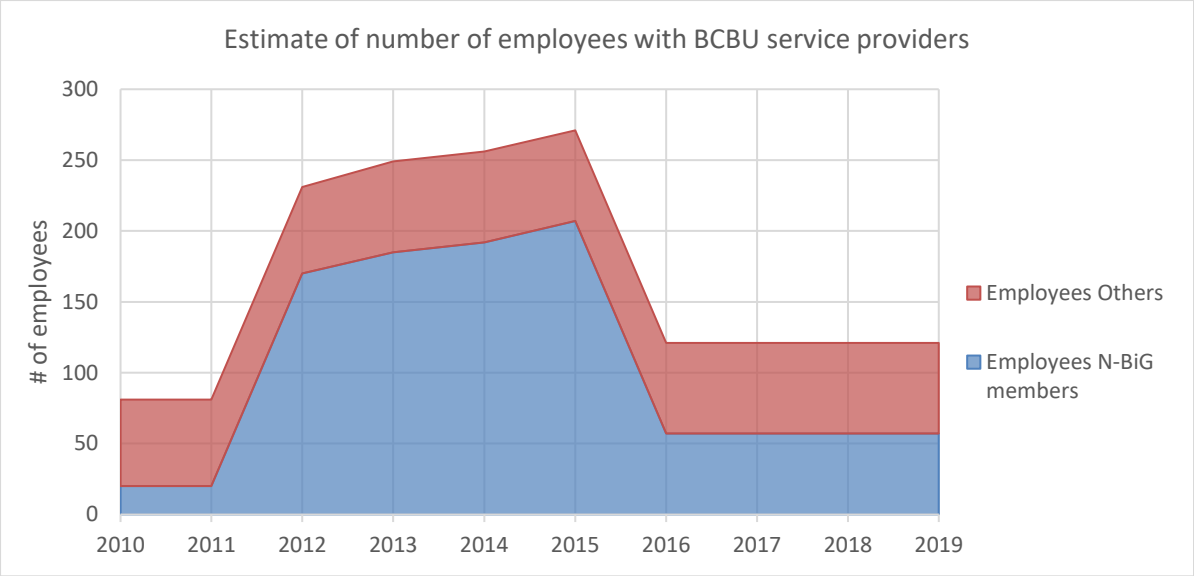

Figure 27: Estimated number of employees with BCBU-related service providers, 2010-2019.

Summarizing the above, it is estimated that the Namibian bush biomass sector employed about 11,300 people in 2019. Three quarters of these are estimated to be employed at the farm level in line with charcoal production. Altogether, the charcoal subsector is estimated to account for 87% of the sector employment.

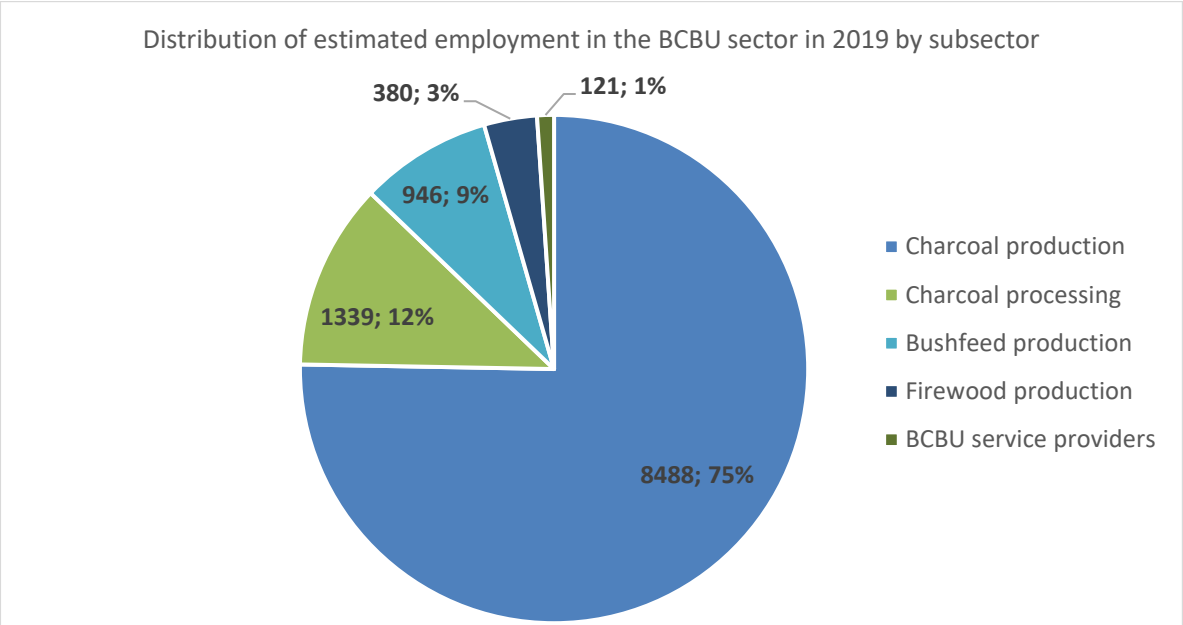

Figure 28: Distribution of estimated employment in the BCBU sector in 2019 by subsector.

3.4 Financial Products

Table 13 provides an overview of financial service providers in Namibia and their respective offerings specific to agricultural and/or BCBU operations. The only two identified financial service providers with tailored products for BCBU-related financing are AgriBank and FNB.

Table 13: Financial service providers in Namibia and their offerings specific to agricultural/BCBU-related financing.

Institution	Type	Financial Instruments	Specific to BCBU	Description
AgriBank	State-owned enterprise	Bush encroachment or deforestation of dry land	Yes	"This scheme is aimed at combating bush encroachment in the country. The scheme will enable present land units that are uneconomical to manage to be changed into economical units and increase the capacity or production per hectare of the unit which can provide higher returns. Loans will be available in two forms: loans where manual labour is applied and loans where aerial spraying is to be used. The maximum repayment period is 15 years."
Bank Windhoek	Commercial bank	AgriSave, AgriCheque, AgriSelekt accounts	No	Range of agricultural banking products called AgriSave, AgriCheque and AgriSelekt, "specifically tailored to meet the financial needs of the modern farming professional irrespective of the size, nature or type of agricultural activity."
Development Bank of Namibia	State-owned enterprise	Various	No	"DBN does not participate in direct agriculture as this is the mandate of Agribank of Namibia, however it may participate in agri-industry to add value to the produce of the agricultural sector. DBN also does not provide microfinance but may provide apex microfinance for on lending to microlenders with specific beneficial development outcomes."
First National Bank	Commercial bank	FNB De-bushing Loan	Yes	First Bush thinning Loan in Namibia. 10-year loan with capital and interest payback from year 4.
Nedbank Namibia	Commercial bank	Various	No	
Standard Bank Namibia	Commercial bank	Various	No	
Trustco Bank Namibia	Commercial bank	Drought relief	No	Trustco Bank Namibia offers all farmers up to 9% interest on medium term investments from their slaughter proceeds.

Financial products: Bottom-up estimate from farm-level survey

Table 14 summarizes the numbers survey respondents by farm type who are aware of, applied for and made use of special financial products for BCBU-related operations in 2019. Of the 213 farm-level survey respondents, 136 (64%) indicated that they are aware of such special financial products. However, when asked to specify these products, most respondents simply referred to AgriBank as well as the commercial banks as listed above. Of the 136 respondents who indicated they were aware of such products, only 10 applied for a product. Out of these 10, six indicated that they made use of a financial product.

Table 14: Number of farm-level survey respondents by farm type who indicated they are aware of, applied for and made use of financial products to finance their BCBU operations.

Farm type	Total # of respondents	# aware of financial products	# applied for financial products	# received financial products
Commercial (free- or leasehold)	138	99	8	5
Resettlement farm	35	22	2	1
Communal farm	24	14	0	0
Government farm	16	1	0	0

The financial product/support received by the resettlement farmer was specified as 'Councillor's office food for work'. The other resettlement farmer who had indicated that he had applied for a product had applied with FNB,

but not received/made use of the financial product. Of the remaining five products, which were all received by commercial farmers, one was linked to FNB and one to Bank Windhoek. For the remaining three, the financial institution was not specified.

Extrapolation of the figures for the commercial farmers to the national level was done based on rough assumptions: We estimated the total number of commercial farms at 6,000. The extrapolation factor of 0.25 takes into account that i) bush encroachment affects roughly half of the commercial farming areas (i.e. factor of 0.5) and ii) the sample is not representative in terms of interest/activity in BCBU and the activities of the actual farming community are assumed to occur at 50% intensity (i.e. another factor of 0.5, which yields a total of 0.5 x 0.5 = 0.25). The resulting estimate amounts to about 90 commercial farmers having applied for financial products to finance their BCBU-related operations and between 50 and 60 eventually having made use of a financial products from a formal financial institution in 2019. No corresponding figures could be derived for resettlement farmers.

The above figures suggest that the financial instruments in place for BCBU-related operations are still hardly accepted/made use of.

3.5 Research and Development

While the scale and impact of bush encroachment and BCBU are large and not only relevant for Namibia, dedicated research to address the numerous open questions is scarce. Within Namibia, NUST and UNAM are active in conducting corresponding research. A range of relevant research projects was funded under the first SASSCAL research portfolio between 2013 and 2018, with these two institutions being the main funding recipients in Namibia. The second SASSCAL research portfolio is slated to begin in 2021 and will likely include research projects of relevance for BCBU.

Currently ongoing projects include

- Biomass Utilization through Sustainable Harvest (BUSH) project. The current project phase is running from 2018 until 2021 and is co-financed by the MEFT/GIZ BCBU project and NUST. The project focuses on applied research towards technology and capacity development for sustainable BCBU in Namibia through various sub-projects. The long-term vision is to establish a center of excellence with regards to BCBU-related knowledge and research at NUST.
- Options for Sustainable Land Use Adaptations in Savannah Systems (ORYCS). The project is running from 2018 until 2022 and is funded by the German Federal Ministry of Education and Research. The project aims to scientifically assess wildlife-based land use options in Namibia based on a combination of field-based, experimental, remote sensing and modelling approaches.

Table 15: Past and ongoing research projects relevant for BCBU in Namibia.

Title	PI	Institution	Year Start	Year End	Weblink
The impacts of fire on biodiversity and ecosystem processes in woodland savannah	Dave Joubert/ Ben Strohbach	NUST	2013	2018	http://www.sasscal.org/tasks
Development of a national forest monitoring programme	Nichola Knox	NUST	2013	2018	http://www.sasscal.org/tasks
Forest regeneration, growth rates, threads, and trends in different forest types	Vera de Cauwer	NUST	2013	2018	http://www.sasscal.org/tasks
Landscape literacy	Ibo Zimmermann	NUST	2013	2018	http://www.sasscal.org/tasks

Title	PI	Institution	Year Start	Year End	Weblink
Impact of bush encroachment on ground water resources	Dave Joubert	UHH	2013	2018	http://www.sasscal.org/tasks
Vegetation survey of Namibia	Ben Strohbach	NUST	2013	2018	http://www.sasscal.org/tasks
Adaptation to climate change impacts in mixed crop-livestock production systems in southern Africa	Moses Cho	CSIR	2013	2018	http://www.sasscal.org/tasks
OPTIMASS	Florian Jeltsch, Niels Blaum	Uni Potsdam	2014	2018	http://www.optimass.org/fileadmin/projects/optimass/OPTIMASS_broschure_final_low.pdf
ORYCS	Blaum/ Hauptfleisch	Uni Postdam/ NUST	2018	2022	https://www.orycs.org/
BUSH	Evert Strydom	NUST	2018	2021	http://bush.nust.na/
SASSCAL Research Portfolio 2			2021	2024	http://www.sasscal.org/

There are still many open questions with regards to the drivers, dynamics and impacts of bush encroachment and BCBU in the Namibian context. In particular, the various environmental impacts of bush encroachment and BCBU have not yet been thoroughly quantified in Namibia. For some impacts, such as changes in ecosystem-level carbon sinks, not only the magnitude but even the direction of the change is uncertain and subject of controversy. This makes consistent policy-making difficult, particularly with regards to the establishment of international value chains. Therefore, there is urgent need for further research to answer these questions and accurately quantify the impacts of bush encroachment and BCBU in Namibia.

4 Sustainability and Consolidation of Sector M&E System

4.1.1 Future Sector Monitoring

In order to continuously capture the temporal development and trends of the Namibian bush biomass sector, it is recommended that the status of all indicators be updated once per year for the respective previous year. Shorter update intervals are not recommended since this would add little additional value and would have a high cost: benefit ratio. For the near future (at least the next five years), it is recommended that these updates, i.e. data collection, entry, analysis, and dissemination, be coordinated by the DAS. Most indicators related to the charcoal subsector are monitored by the NCA and can be shared in annually aggregated form.

4.1.1.1 DATA COLLECTION

The current approach to data collection combined a farm-level survey for bottom-up data and targeted collection of top-down and primary data from key stakeholders. This proved useful in that it provided various independent estimates for numerous indicators, thus allowing for some degree of triangulation and consistency-checking of assumptions.

Table 16 lists the main sources for each indicator. Corresponding contacts are stored in the survey database which was handed over to the DAS. Note that the status of most of the indicators could be estimated/derived from top-down and primary data from key stakeholders only but would then not provide the current level of redundancy in terms of different estimates. Also, for some subsectors which are not (yet) organized and/or formalized (e.g. bush-based animal feed), there is currently no other source than farm-level surveys.

For future farm-level surveys, the survey database established in line with the present assignment is expected to serve as a key resource. It is recommended that the database be updated continuously to increase the sampling frame and possibly its representativeness. The phone-based approach to the farm-level survey achieved a response rate of 52% and is considered more efficient and effective than either physically visiting farms or deploying the survey via email. As the participants in the current farm-level were asked about their willingness to participate in this kind of survey on an annual basis and also indicated their preferred survey medium (phone or email), there is already a core sample in place, which can be enhanced with time.

Most stakeholders will require and appreciate human interaction and repeated follow-ups, even in case of a rigidly structured survey. Therefore, we consider the current potential for automated routine data collection through web-based tools as very low. Furthermore, the analysis, interpretation and aggregation of the data collected requires significant amount of time and can hardly be automated.

Yet, there is potential for streamlining some of the data collection processes by some of the major sector stakeholders. These are briefly discussed in the following sections.

Table 16: Sector indicators and the main sources for corresponding data/estimates.

#	Indicator	Main Sources	Data collection tool(s)
BC1	Area under bush control by method p.a. (ha)	• Directorate of Forestry • Forest Stewardship Council (group schemes) • Ministry of Environment, Forestry and Tourism • Private sector • Farm-level survey	• DoF permit system • FSC group scheme spreadsheets • MEFT ECC system • Individual data request/key informant interview Farm-level survey
BC2	Individual/company applications for environmental clearance certificates on BCBU from MEFT	• Ministry of Environment, Forestry and Tourism	• MEFT ECC system
BC3	Commercial/own use applications for permits on BCBU from DoF	• Directorate of Forestry	• DoF permit system

#	Indicator	Main Sources	Data collection tool(s)
BC4	Number of permits issued by DoF p.a	• Directorate of Forestry	• DoF permit system
BC5	Area under bush control on government research farms (ha)	• Directorate of Forestry	• Individual data request/key informant interview
BC6	Amount of chemicals imported and sold p.a (tons)	• Namibia Statistics Agency • Private sector	• Individual data request/key informant interview
DA1	Number of DAS in house contacts maintained.	• De-bushing Advisory Service	• Internal DAS activity records
DA2	Number of Farmers Union (NAU, NECFU, NNFU) trained in BCBU p.a.	• De-bushing Advisory Service	• Internal DAS activity records
DA3	Number of government extension officers (DOF, DAPEES, DARD, MEFT) trained in BCBU p.a.	• De-bushing Advisory Service	• Internal DAS activity records
DA4	Number of participants at DAS Workshops / Trade shows p.a.	• De-bushing Advisory Service	• Internal DAS activity records
DA5	Number of participants at farmer information days p.a.	• De-bushing Advisory Service	• Internal DAS activity records
DA6	Number of private extension officers (Agra ProVision, CCF, Komeho, Agribank), trained in BCBU p.a.	• De-bushing Advisory Service	• Internal DAS activity records
DA7	Percentage (%) of farmers satisfied with DAS/N-BiG services.	• De-bushing Advisory Service • Farm-level survey	• Internal DAS activity records • Farm-level survey
EM1	Number of other employees outside the employment of NCA and N-BiG members in BCBU	• Private sector • Farm-level survey	• Individual data request/key informant interview • Farm-level survey
EM2	Number of people employed by N-BiG members who are active in BCBU	• Namibia Biomass Industry Group	• N-BiG internal survey/reporting
EM3	Number of people employed by NCA charcoal processors by gender	• Namibia Charcoal Association	• NCA internal survey/reporting
EM4	Number of people employed by NCA charcoal producers by gender p.a.	• Namibia Charcoal Association	• NCA internal survey/reporting
EM5	Number of people employed in the bush-based animal feed value chain	• Namibia Biomass Industry Group • Namibia Statistics Agency • Farm-level survey	• Individual data request/key informant interview • Farm-level survey
EM6	Number of N-BiG members.	• Namibia Biomass Industry Group	• N-BiG internal survey/reporting
EM7	Number of NCA members	• Namibia Charcoal Association	• NCA internal survey/reporting
FI1	Number of end-users making use of financial products and services for BCBU p.a.	• Financial Institutions • Farm-level survey	• Individual data request/key informant interview • Farm-level survey
FI2	Number of all applicants for loans for BCBU activities (both successful and unsuccessful) p.a.	• Financial Institutions • Farm-level survey	• Individual data request/key informant interview • Farm-level survey
MB1	Number of enterprises in charcoal production	• Namibia Charcoal Association • Namibia Statistics Agency • Forest Stewardship Council	• NCA internal survey/reporting • FSC group scheme spreadsheets • Individual data request/key informant interview
MB10	Number of active enterprises under DoF bush control tender programmes p.a.	• Directorate of Forestry	• NA
MB2	Number of enterprises/farmers active in bush-based animal feed production	• MAWLR • Farm-level survey	• Individual data request/key informant interview • Farm-level survey

#	Indicator	Main Sources	Data collection tool(s)
MB3	Amount of charcoal produced p.a. (tons)	• Namibia Charcoal Association • Namibia Statistics Agency • Forest Stewardship Council • Farm-level survey	• NCA internal survey/reporting • Individual data request/key informant interview • Farm-level survey
MB4	Amount of charcoal exported per continent p.a (tons)	• Namibia Charcoal Association • Namibia Statistics Agency	• NCA internal survey/reporting • Individual data request/key informant interview
MB5	Amount of bush-based animal feed produced p.a. (tons)	• Namibia Statistics Agency • Farm-level survey	• Individual data request/key informant interview • Farm-level survey
MB6	Amount of biomass products other than charcoal commercially traded (tons)	• Namibia Biomass Industry Group • Namibia Statistics Agency • Private sector • Farm-level survey	• N-BiG internal survey/reporting • Individual data request/key informant interview • Farm-level survey
MB7	Number of active enterprises in the sector other than charcoal producers and processors.	• De-bushing Advisory Service • Namibia Biomass Industry Group • MIT	• N-BiG internal survey/reporting • Individual data request/key informant interview
MB8	Number of enterprises in charcoal processing	• Namibia Charcoal Association	• NCA internal survey/reporting
MB9	Number of SMEs trained and certified in BCBU p.a.	• De-bushing Advisory Service • Namibia Biomass Industry Group • Namibia Charcoal Association	• Internal DAS activity records • N-BiG internal survey/reporting • NCA internal survey/reporting
OC1	Number of non-DAS-organized BCBU-related events by category	• Namibia Biomass Industry Group • Namibia Charcoal Association	• N-BiG internal survey/reporting • NCA internal survey/reporting
OC2	Number of exhibitors at the annual Biomass Technology Expo	• De-bushing Advisory Service • Namibia Biomass Industry Group	• Internal DAS activity records • N-BiG internal survey/reporting
OC3	Number of mentors in the sector trained through mentorship programmes p.a.	• De-bushing Advisory Service	• Internal DAS activity records
OC4	Number of participants at the annual Biomass Technology Expo	• De-bushing Advisory Service • Namibia Biomass Industry Group	• Internal DAS activity records • N-BiG internal survey/reporting
RD1	Number of research projects on bush-based topics or linked to BCBU	• NUST • UNAM • NCRST • SASSCAL	• Individual data request/key informant interview

4.1.1.2 DATA DISSEMINATION

Since the success of data collection and accuracy of the monitoring data to a large degree depends on the voluntary participation of sector stakeholders, above all farmers and the private sector service providers, it is important that mechanisms are in place to report back to these contributing stakeholders. At the same time, it is crucial that personal or business data be protected and be prevented from being disseminated in the public domain unless the respective data providers explicitly authorize that their names can be mentioned.

It is recommended that each annual indicator update be complemented by a brief update report containing aggregate sector figures and which can be made available via the DAS website.

Optionally, a web-based dashboard featuring basic visualization and reporting tools for the collected indicator data and could thus serve as a digital platform for public access to the (aggregated) sectoral data.

5 Recommendations

Future Data Collection

- Given the heterogeneity and nature of data sources spanning the entire bush biomass sector, we consider it unlikely that data collection and analysis can be automated to a significant degree. We therefore recommend that
    - Annual updates of the indicator framework be done through regular data collection campaigns conducted by a core team under the coordination of the DAS
    - Data collection be done largely manually, i.e. through direct (phone, email, in-person) engagement between data collectors and data providers
    - Data interpretation, analysis and aggregation be done largely manually, based on transparent assumptions and formulas which are to be reviewed regularly to account for dynamics in the sector
- Annual updates of the indicator framework are expected to be feasible within 4 months by an in-house core team of 1-2 persons plus a small team of external enumerators (could be students in line with an internship).

Contributions by Key Sector Stakeholders

- Namibia Charcoal Association: The NCA has its own internal M&E system and is not allowed to share member-specific data externally. Therefore, only aggregated data can be provided by the NCA. With regards to future sector indicator updates, we recommend that the NCA routinely integrate the following data requests from their members:
    - Amount of charcoal produced
    - Area under bush control, disaggregated by method
    - Number of employees, disaggregated by gender
- MEFT Directorate of Forestry: The current DoF permit system is paper-based and (meta-)data on permit applications and permits issued is not captured systematically and uniformly in digital form. The current system does thus not yield the data required to determine the status of the indicators BC3 and BC4. We recommend that
    - In the short-term, the DoF adopt a basic system to systematically digitize and centrally archive the permit data from the year 2019
    - In the mid-term, the DoF adopt a fully digitized permit system. This will require building considerable capacities in-house for operating and maintaining the system. In line with this development, the DoF permit system and the MEFT ECC system could be harmonized or even fully integrated.
- MEFT Department of Environmental Affairs:
    - The current database of the digital ECC system cannot be queried specifically according to BCBU-related categories. We recommend that the categories are revised, or corresponding keywords be added to enable corresponding database queries.
    - We recommend that the affected area in line with an ECC be captured consistently, ideally by capturing spatial polygons in the system.

Data Dissemination

- The web-based M&E platform in its current form provides limited functionality to appropriately present sector data to the public. We recommend that
    - Either, the current web-based platform be enhanced to increase flexibility, user-friendliness, and attractiveness, or
    - Annual sector updates be presented to the public via annual update reports, which can be provided via the DAS website along with a spreadsheet containing all indicator data.

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Annex

A1 Full Indicator Data 2014 - 2019

Table 17: Full indicator data for the years 2014 until 2019.

Output	#	Indicator	2014	2015	2016	2017	2018	2019
BUSH CONTROL ACTIVITIES	BE1	Estimated area affected by bush encroachment (ha)	-	45,000,000	-	-	-	-
	BC1	**Area under bush control by method p.a. (ha)**	**178,182**	**212,408**	**205,000**	**207,277**	**230,280**	**306,427**
	BC1	Chemical (ha)	48,071	73,731	64,583	58,332	64,463	66,979
	BC1	Manual/Semi-mechanized (ha)	117,144	127,544	125,824	133,187	148,863	222,295
	BC1	Mechanized (ha)	12,967	11,133	14,592	15,758	16,954	17,153
	BC1	FSC-certified area (ha)	97,692	132,328	149,441	183,812	438,470	1,407,802
	BC1	Area after-treated (ha)	16,574	11,026	9,095	16,040	20,864	21,224
	BC2	**Individual/company applications for environmental clearance certificates on BCBU from MEFT**						**No data**
	BC3	**Commercial/own use applications for permits on BCBU from DoF**						**No data**
	BC4	**Number of permits issued by DoF p.a**						**No data**
	BC5	**Area under bush control on government research farms (ha)**						
	BC6	**Amount of chemicals (imported and) sold p.a (tons)**	**-**	**293**	**230**	**200**	**228**	**237**
	BC6	Imports of herbicides, anti-sprouting products and plant-growth regulators (380893) - kg	456,295	303,548	250,398	441,592	574,407	584,304
	BC6	Liquid chemicals sold p.a. (t)		70.00	60.00	60.00	60.00	60.00
	BC6	Solid chemicals sold p.a. (m3)		223.00	170.00	140.00	168.00	177.00
EMPLOY-MENT CREATION	**EM1**	**Number of other employees outside the employment of NCA and N-BiG members in BCBU**						**444**
	EM1	Firewood production - farm-level						380
	EM1	Service providers, e.g. De-bushing	64	64	64	64	64	64
	EM2	**Number of people employed by N-BiG members who are active in BCBU**	**192**	**207**	**57**	**57**	**57**	**57**
	EM3	**Number of people employed by NCA charcoal processors by gender**	**791**	**879**	**976**	**1,085**	**1,205**	**1,339**
	EM3	Number of people employed by NCA charcoal processors by gender - female	368	409	454	505	561	623
	EM3	Number of people employed by NCA charcoal processors by gender - male	423	470	522	580	644	716
	EM4	**Number of people employed by NCA charcoal producers by gender p.a.**	**4,463**	**4,860**	**4,795**	**5,077**	**5,676**	**8,488**
	EM4	Number of people employed by NCA producers by gender p.a. - female	406	442	436	462	516	772

Output	#	Indicator	2014	2015	2016	2017	2018	2019
	EM4	Number of people employed by NCA producers by gender p.a. - male	4,057	4,418	4,359	4,615	5,160	7,716
	EM5	**Number of people employed in the bush-based animal feed value chain**	**-**	**-**	**-**	**-**	**-**	**946**
	EM5	People employed in bush feed value chain - registered producers						36
	EM5	People employed in bush feed value chain - production for own use						910
	EM6	**Number of N-BiG members.**					**88**	**102**
	EM7	**Number of NCA members**			**282**	**587**	**768**	**954**
FINANCIAL PRODUCTS	**FI1**	**Number of end-users making use of financial products and services for BCBU p.a.**						**54**
	FI2	**Number of all applicants for loans for BCBU activities p.a.**						**87**
	MB1	**Number of enterprises in charcoal production**	**116**	**123**	**379**	**672**	**852**	**1,107**
	MB1	Number of enterprises in charcoal production - FSC certified	16	20	22	24	64	232
	MB1	Number of enterprises in charcoal production - uncertified	100	103	357	648	788	875
	MB2	**Number of farmers active in bush-based animal feed production (including own-use)**	**-**	**-**	**-**	**-**	**-**	**861**
	MB2	Registered commercial producers	-	-	-	-	-	6
	MB2	Own-use production / unregistered sale						855
	MB3	**Amount of charcoal produced p.a. (tons)**	**109,527**	**119,297**	**117,682**	**124,599**	**139,327**	**208,320**
	MB3	Total amount of charcoal produced p.a. - FSC (tons)	27,392	34,240	42,800	59,000	75,000	120,000
	MB3	Total amount of charcoal produced p.a. - uncertified (tons)	82,135	85,057	74,882	65,599	64,327	88,320
	MB4	**Amount of charcoal exported per continent p.a (tons)**	**109,527**	**119,297**	**117,682**	**124,599**	**139,327**	**185,820**
MARKET AND BUSINESS DEVELOP-MENT	MB4	Amount of charcoal exported per continent p.a (tons) - Europe	25,580	32,967	36,918	39,955	53,261	79,750
	MB4	Amount of charcoal exported per continent p.a (tons) - South Africa	80,765	80,718	72,596	77,052	79,898	99,016
	MB4	Amount of charcoal exported per continent p.a (tons) - Other	3,181	5,612	8,168	7,592	6,168	7,054
	MB5	**Amount of bush-based animal feed produced p.a. (tons)**						**102,914**
	MB6	**Amount of biomass products other than charcoal commercially traded (tons)**	**35,500**	**48,000**	**55,500**	**55,500**	**55,852**	**96,173**
	MB6	Woodchips	25,500	38,000	45,500	45,500	45,852	34,233
	MB6	Bushbloks	10,000	10,000	10,000	10,000	10,000	10,000
	MB6	Firewood						51,940
	MB7	**Number of active enterprises in the sector other than charcoal producers and processors.**	**7**	**8**	**8**	**8**	**8**	**8**
	MB7	Number of active enterprises in the sector - Non-charcoal biomass products	4	5	5	5	5	5
	MB7	Number of active enterprises in the sector - peripheral services, e.g. de-bushing, machines	3	3	3	3	3	3

Output	#	Indicator	2014	2015	2016	2017	2018	2019
	MB8	**Number of enterprises in charcoal processing**	**9**	**9**	**11**	**11**	**13**	**26**
	MB9	**Number of SMEs trained and certified in BCBU p.a.**						**2**
	MB10	**Number of active enterprises under DoF bush control tender programmes p.a.**						
OUTREACH & CAPACITY BUILDING BY DAS	**DA1**	**Number of DAS in house contacts maintained.**			**67**	**106**	**153**	**310**
	DA2	**Number of Farmers Union (NAU, NECFU, NNFU), trained in BCBU p.a.**						**1**
	DA3	**Number of government extension officers (DOF, DAPEES, DARD, MEFT), trained in BCBU p.a.**						**47**
	DA4	**Number of participants at DAS Workshops / Trade shows p.a.**			**42**	**120**	**117**	**121**
	DA5	**Number of participants at farmer information days p.a.**			**122**	**73**	**206**	**127**
	DA6	**Number of private extension officers (Agra ProVision, CCF, Komeho, Agribank), trained in BCBU p.a.**						**3**
	DA7	**Percentage (%) of farmers satisfied with DAS/N-BiG services.**			**87%**	**95%**	**No data**	**No data**
RESEARCH & DEVELOP-MENT	**RD1**	**Number of research projects on bush-based topics or linked to BCBU**	**8**	**8**	**8**	**8**	**10**	**2**
SECTOR OUTREACH AND CAPACITY BUILDING	**OC1**	**Number of non-DAS-organized BCBU-related events by category**			**2**	**2**	**4**	**5**
	OC1	NCA Field/Tech/Training days			-	-	2	3
	OC1	NCA Expo			1	1	1	1
	OC1	NCA AGM			1	1	1	1
	OC2	**Number of exhibitors at the annual Biomass Technology Expo**						**30**
	OC3	**Number of mentors in the sector trained through mentorship programmes p.a.**						**8**
	OC4	**Number of participants at the annual Biomass Technology Expo**						**385**

A2 Stakeholder Engagement and Consultations

Table 18: Institutions and respective persons consulted in addition to the farm-level survey.

Institution	Contact person(s)
Biomass Producers Namibia	Albert Basson
Carbo Namibia (Pty) Ltd	Frank Detering
CCF Bush (Pty)	Bruce Brewer
CMO (Namibia) (Pty) Ltd	Corris van den Berg; Michal Brink
Direct Charcoal	Franz Holzkampf
Directorate of Forestry	Fillemon Kayofa; Joseph Hailwa; Michael Otsub; Theodor Kaambu
Forest Stewardship Council	Manushka Moodley
Jumbo Charcoal (Pty) Ltd	Ian Galloway; Stephan Bezuidenhout
Meat Board of Namibia	Desmond Cloete
Ministry of Environment, Forestry and Tourism	Damian Nchindo; Saima Angula; Timoteus Mufeti
Ministry of Agriculture, Water and Land Reform	Melania Iiputa
Namagri	Alex McDonald
Namibia Agricultural Union	Roelie Venter
Namibia Charcoal Association	Michael Degé
Namibia Emerging Commercial Farmers Union	Dr NAC Nghifindaka - Tjiuongua
Namibia National Farmers Union	Beata Xulu; Daisy Manungo; Veii Vesee
Namibia Statistics Agency	Elijah Saushini
Namibia University of Science and Technology	Evert Strydom
Odussa Trading	Danie Swanepoel; David Botha
Ohorongo Cement	Franscous Botha
Ombengu CC	Stephan Kondzilewski
Omuriro Biomass Investment	Heiko Meyer; Norbert Liebich
Other Consultants	Dr Axel Rothauge; Dagmar Honsbein; Klaus Schade
SASSCAL	Jörg Helmschrot
University of Namibia	Maria Luisa de la Puerta Fernandez

A3 Farm-Level Questionnaire

De-Bushing Advisory Service:
2019 Baseline survey for the Namibian bush biomass sector
Farm-level questionnaire

Data is collected for the sole purpose of monitoring the extent and nature of the Namibian bush biomass sector and to improve sector support measures and policies for bush control and biomass utilization (BCBU).

Note that all personal data will be treated confidentially. Only aggregated data will be published.

Please note that you can skip any question if you do not feel comfortable answering it. The just fill in "skip". If a question is not applicable to your farm, then please fill in "NA". If you do not know the answer to a question, then please fill in "Unknown".

1 Contact and Farm Information

First and Surname	
Contact phone number	
Contact email	
Membership in Farmer's Union? (NAU, NECFU, NNFU,…)	
In which region is your farm located?	
In which constituency is your farm located?	
Approximate size of farm in hectare	
Farm name	
Farm number	

1.1 What is the farm type (mark with "X" as appropriate)?

Commercial	
Resettlement	
Communal	
Government	

1.2 What is the main farming activity (mark with "X" as appropriate; multiple selection possible)?

Cattle	
Smallstock	
Game	

1.3 How would you describe the degree of bush encroachment on your farm (mark with "X" as appropriate)?

None (Land productivity and grazing not affected)	
Moderate (Land productivity slightly reduces; only parts of farm)	
Severe (Land productivity strongly reduced; most of farm)	
Extreme (Land productivity extremely reduced; entire farm)	

2 Bush Thinning

2.1 General figures

In which year did you start with bush control/ bush thinning activities on your farm?	
How many hectares have been under bush control (i.e. were bush-thinned) on your farm in total over the last five years (i.e. since 2015)?	

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2.2 Area bush thinned on the farm in 2019 by method

Method	Area (hectares)
manual (labour-based with panga and axe) bush-thinning	
semi-mechanized (labour-based with chainsaw) bush-thinning	
mechanical (large-scale equipment like bulldozers, excavators) bush thinning	
biological (fungal, fire, browsers) bush-thinning	
chemical (poison) bush-thinning	

2.3 Land use and aftercare

What is the current land use on the areas where bush-thinning was done in 2019?	
Did you apply aftercare in 2019 to previously bush-thinned areas? If yes, what is the area in hectares to which aftercare was applied in 2019?	
Do you intend to apply aftercare this year to the areas bush-thinned in 2019?	

3 Bush Biomass Utilization

3.1 How many tons of the following bush biomass products have you produced and sold in 2019?

Bush biomass product	Produced 2019 (tons)	Sold 2019 (tons)	Price per ton 2019 (N$ - price at farm gate)
Firewood			
Charcoal			
Wood chips or pellets			
Bushbloks			
Bush-based animal feed			
Poles and droppers			
Biochar			

4 Employment

4.1 What is the number of people employed in 2019 in line with your bush control and biomass utilization operations?

Permanent employees	
Seasonal employees	
Temporary/short-term employees	
Approximate percentage of women among these employees in 2019	
Average monthly salary per labourer in N$ (We are aware that some labourers are paid by ton of bush biomass product, others by the area de-bushed. For comparability, let's try to come up with a best estimate for a salary per month. This should be the average monthly salary figure among all labourers for the year 2019 in N$)	

5 Financial products for farm-level BCBU operations

Are you aware of any special financial products from banks or the government (e.g. special loans, grants, etc.) for farmers to support bush thinning and biomass utilization operations?	
If yes, which are these products (Provider and product name)?	
Have you applied for any special financial products for farmers in 2019 to support bush thinning and biomass utilization operations?	
If yes, for which products have you applied (Provider and product name)?	

Have you received/made use of any special financial products for farmers in 2019 to support bush thinning and biomass utilization operations?	
If yes, which products were those (provider and product name)?	

6 Certification and memberships

6.1 Are you a certified bush biomass producer?

Yes, Forest Stewardship Council (FSC)	
Yes, other	
No	

If "Yes, other": Which certification mechanism?	
If "No": Would you be interested in becoming a certified producer?	

6.2 Are you a member of (mark with "X" as appropriate; multiple selection possible)…

Namibia Charcoal Association (NCA)?	
Namibia Biomass Industry Group (N-BiG)?	
Other bush-biomass-related association (please specify)?	

7 Future contribution to Namibian bush biomass sector M&E system

7.1 Would you be available to participate in this survey on an annual basis (mark with "X" as appropriate)?

Yes	
No	

7.2 What would be your preferred way of participating (mark with "X" as appropriate; multiple selection possible)?

Phone call	
Online survey (via email)	

7.3 Do you have any comments about this survey that you would like to share?

Thank you very much for your participation! Please return the completed questionnaire to survey@d-one.co.

The results of this survey on the Namibian bush biomass sector will be published and shared via the website of the De-Bushing Advisory Service (https://www.dasnamibia.org/) around August 2020.

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